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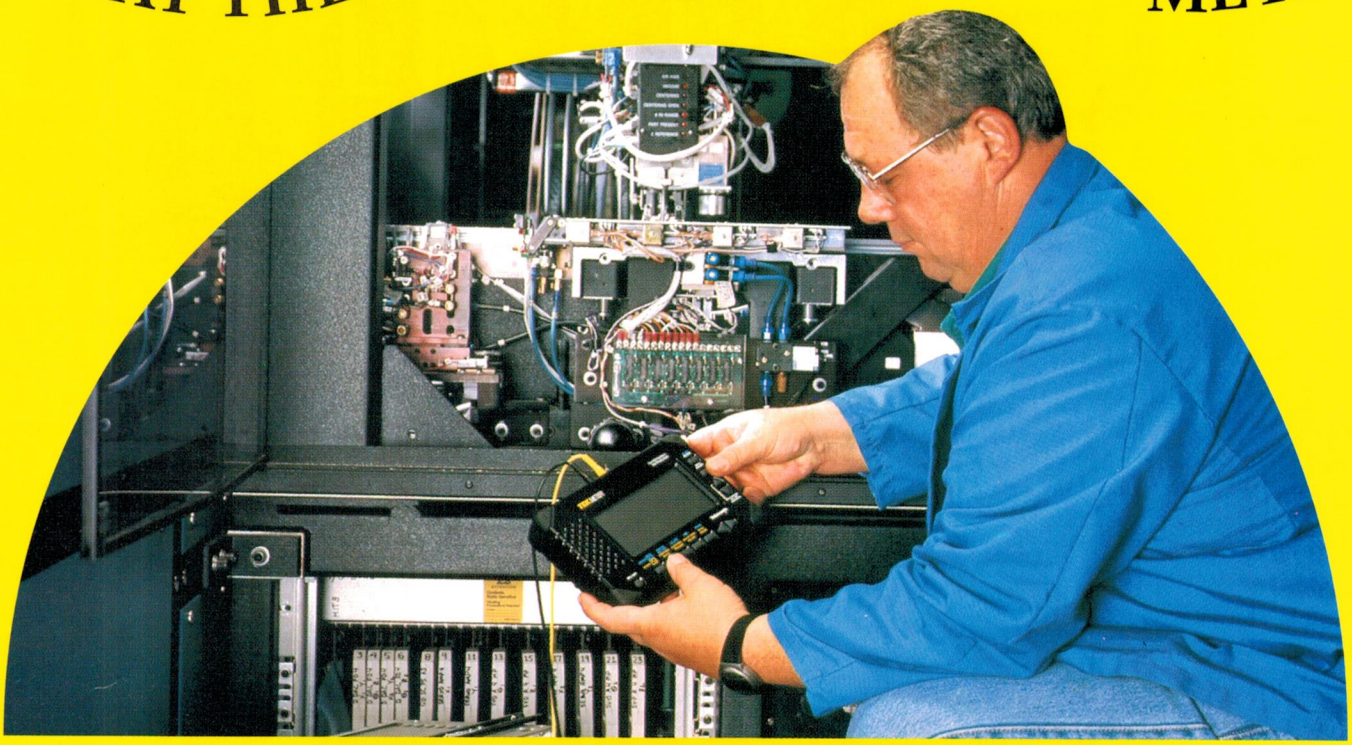

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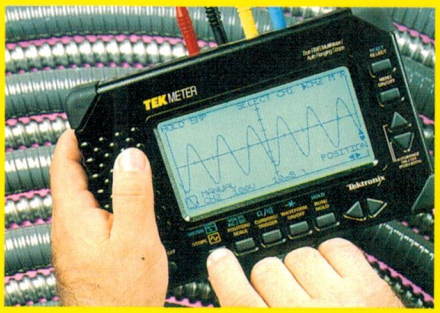
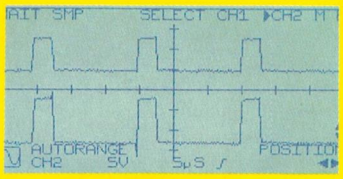
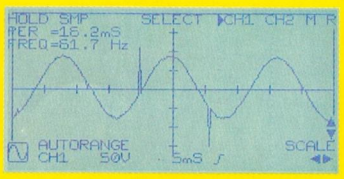


Large LCD Display gives clear indication including Max, Min and Max-Min values.



Dual channel operation allows relative timing of signals to be observed.



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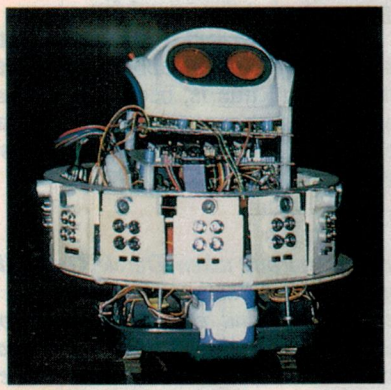
Electronics AUSTRALIA WITH ETI

Volume 56, No.9
September 1994

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Australia's robots



Australian researchers are playing a key role in developing the exciting 'next generation' of robots, as Paul Hendy explains in his feature story starting on page 26.

Calling via satellite

This month Optus rolls out its Mobilesat service, using the 150 watt L-band transponder on its B1 satellite to allow calls from literally anywhere in Australia. Barrie Smith explains how it works, starting on page 16...

On the cover

Musician Steve Lincoln-Smith of Innovative Music Australia is shown giving a performance on the new Yamaha VL1 'Virtual Acoustic' Synthesiser, at a Sydney venue. Louis Challis reviews the VL1 in this issue, starting on page 8. (Photo courtesy Yamaha Music Australia.)

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Projects and Technical

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Columns and Comments

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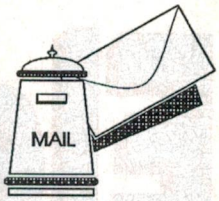
LETTERS TO THE EDITOR



Philips QSO party

If it is possible, please include the following in the next issue of *Electronics Australia:*

Philips World-Wide QSO Party — All amateurs who are currently employed by, or retired from the Philips Organisation are invited to take part in the 1994 QSO Party to be held, probably, during October or November.

The QSO Party is similar to a normal contest, where all modes of communication can be used. Any Philips personnel, not aware of the existence of this contest and would like to participate should contact Ray Dobson, VK5DI and VK5WI, QTHR in Callbook, or via Philips Components, PO Box 1, Alberton SA, 5014.

Ray Dobson, VK5DI,
Fulham, SA.

What's in a word?

Tom Moffat in 'Moffat's Madhouse', June edition, writes that as someone who was brought up under the American Constitution, where many freedoms are specifically guaranteed, he finds it a little worrying that nowhere in the Australian Constitution does the word 'freedom' appear. May I gently remind Mr Moffat that having fine sounding words in a constitution may, at times, be just that; fine sounding.

The USSR had a constitution that guaranteed all sorts of things — a fat lot of good it did the ordinary citizen. And, with all due respect to Mr Moffat, I rather doubt that having the word 'freedom' meant much to the American blacks, until fairly recent times.

As Sir Walter Scott wrote in *The Legend of Montrose* (1819): 'There is a Southern Proverb — Fine Words Butter No Parsnips'.

Anthony Heathcote,
Carnegie, Vic.

Those abbreviations!

If you read in a magazine the following passage 'It is necessary to fit an IO after each change of direction, and downstream of each DT and BT, it may not be required on the EV branch', there would be a fair chance that you may not understand what the letters stand for — yet to a plumber it is everyday language.

To people like yourself, who have been engaged in electronics most of their life, the abbreviations that are becoming more numerous, in *EA* (e.g., LNB, DSO, CCD, and a host of others) may be no problem at all, but to a plumber who likes to dabble in electronics and read *EA*, it becomes increasingly difficult to figure out what they stand for.

I would be pleased if you could (at the start of the use of the abbreviation) state what the full title is, because I am sure there must be more than just me perplexed by the use of strange initials to describe items.

Derek Logan,
Hobart, Tas.

Comment: Point taken, Derek! Our policy for some time has been to do exactly as you suggest, and explain abbreviations the first time they're used in any article. But it sounds like we've become a bit slack, so we'll try harder. Thanks for the reminder.

Catalog bouquet

I have just received my July copy of *EA* and read 'Catalog hassle', and would like to spring to your and Jaycar's defence.

I too had the same problem as David Grubb, but I read my magazine more thoroughly and cut out the coupon for the catalog and sent it to Jaycar. In a short while the catalog arrived post paid with a packet of LEDs free of charge. I was well pleased.

Similarly I live an 88 kilometre round trip from a dealer which in my case includes a ferry trip costing $11.00, so I am loathe to drive to Hobart on cost alone — besides finding, or should I say not finding, what I want on the dealers shelf (a too common occasion).

So I use Jaycar's 008 number quite frequently, and I find their service to be efficient and courteous. If I phone on Monday or Tuesday I usually have the goods by the end of the same week and I reckon that's good by anybody's standards. There have been the occasional hiccups, but you would have to be very picky to take issue with them.

I realised when I first came to Tasmania that I would have trouble getting some items for my more esoteric hobbies and began straight away to use mail order from as far away as the

UK and the US. Once you get used to the pause between order and delivery everything is fine.

It's quite a thrill to get a parcel of 'goodies' from somebody you haven't met, and read the 'foreign' newspapers they're wrapped in.

Bernard Bechet,
Barnes Bay, Tas.

Plea from NZ

The Bouquet:

As a regular reader of *EA* since about 1949, let me say how much I enjoy your magazine. I believe it to be one of the best in the world (I get a lot of them...). So please keep up the good work.

The Brickbat:

When you have a special offer on say subscriptions, how come it is always for 'Australian residents only' — what is wrong with we Kiwis from the Shakey Islands?

Is it because your advertisers don't see us as a potential market? Then let me disabuse them. I order more products direct from Australia than I purchase locally, all advertisements from your magazine. This I suggest would be the position of many of your readers from New Zealand.

Let's face it, we do not have a lot of choice over here — so come on, give us a go, mate!

Robert J. Hall,
Waitakere City, NZ

Comment: It's not that we don't value our New Zealand readers, Robert, but more a problem with transport costs and GST complications. Still, we'll see if we can get the company to relax its opposition...

Watts, not volts

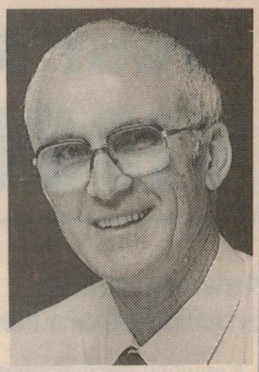
I refer to my letter regarding the Challis valve amplifier review, which appeared on pages 4 and 5 of *EA* for May 1994.

In the penultimate paragraph, the quantity '70kV' should read '70kW'. Unfortunately, upon reflection, the 'W' produced by my printer does resemble a 'V' to some extent and that is no doubt the cause of the error. Perhaps I should have written it out in full as '70 kilowatts'. Sorry about that!

Winston T. Muscio,
Leumeah, NSW

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



Australia's achievements in robotics research, satellite phones

We have a lot of interesting reading for you again this month. One of the articles I'd especially recommend is Paul Hendy's feature on the leading role being played by Australian researchers in robotics, starting on page 26. This is a real 'good news' story, as I'm sure many of us haven't realised the amount of important work being done by Australians in this area — or the impressive achievements that have been made in fields like machine vision, autonomous mobile robots and micro mechanisms.

Did you ever wonder what became of that 150 watt L-band transponder and its array of antennas on the Optus B1 satellite? I know I did; they were promoted quite strongly when the satellite was launched, but after that there was a long period of silence about them. Well, they're finally coming into use this month, as Optus rolls out its Mobilesat service — a satellite based mobile telephone system that covers *all* of Australia in one fell swoop. Barrie Smith's story starting on page 16 explains what it's all about, and I'm sure you'll find it as interesting as I did.

Another very interesting item is Louis Challis' writeup on Yamaha's new VL1 'Virtual Acoustic' synthesiser, starting on page 8. Louis professes that until now, electronic synthesisers left him rather unimpressed — but when he heard the VL1 in action, he had to revise his opinion quite dramatically. It's based on entirely new music synthesis technology, involving a thorough 'back to basics' modelling of just how traditional musical instruments produce their sounds, and Louis reports that judging from the result, this is a major breakthrough.

By the way, we've made special arrangements with Yamaha Music Australia, to offer *EA*'s readers a special demonstration CD of the VL1 being played by performer Steve Lincoln-Smith, for only $6.00 including postage. The CD has only about 15 minutes of programme, but it certainly gives a good idea of the amazing things a VL1 can do in the hands of a skilled musician. For details of the offer, see page 8.

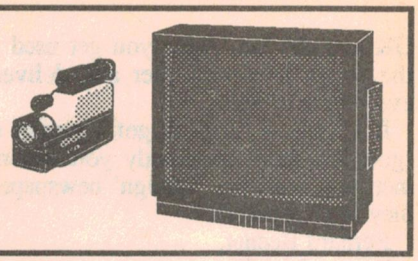
On the project side, we have a new design by Rob Evans for a really neat active crossover for subwoofers. This is another of Rob's meticulously planned designs, offering a very high level of performance coupled with low cost and ease of assembly. There's also an impressive little wideband RF preamp design from Bob Barnes of RCS Radio, who calls it the Super Ducky because it's designed to boost the signal-collecting ability of 'rubber ducky' and similar small antennas as used for indoor reception. It does, too — in tests, the Super Ducky with a tiny rubber ducky antenna brought in some VHF signals that an outdoor discone antenna just didn't 'hear'...

We also have part three of Rob's description of the IMP PC-based loudspeaker testing system, a new design for a laser diode drive circuit, and details of a low cost and educational micro-based number converter kit (in Experimenting with Electronics). Plus all of our regular features and departments, of course.

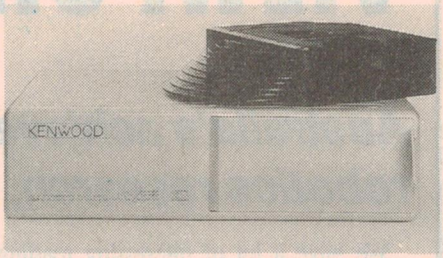
Your only problem might be to finish reading this issue, before the next arrives — so perhaps you can have too much of a good thing!

Jim Rowe

What's New in VIDEO and AUDIO



New car audio products from Kenwood



Kenwood has announced a new car CD player/receiver line up, together with a multiple auto CD changer. The line up consists of the KDC-7002, KDC-6002 and KDC-5002 CD player/receiver and the KDC-C602 multiple-auto CD changer. The new models boast rounder, slimmer features and are distinctly different from the company's previous car audio products.

The three CD player/receivers all support Kenwood's Theft Deterrent Faceplate design that enables the faceplate to be simply removed from the unit, disabling the system completely. All models can be configured to drive front and rear speakers and/or drive other power amplifiers, and feature an easy to read four way selectable liquid crystal display.

The flagship model, the KDC-7002 offers 25W x 4, preset fader and two sets of pre-outs. Quad single-bit state of the art D/A converters with eight times oversampling are the heart of the system and support Kenwood's award winning Digital Pulse Axis Control technology for a clean jitter free sound.

The less expensive KDC-6002 offers similar features (but does not include remote control) including Kenwood's TM-100 anti-interference IC tuner with switchable CRSC multi-path technology. The KDC-5002 offers a two way selectable LCD and similar features to the KDC-6002, however power ouput is 8W into four channels.

The KDC-C602 10 disc CD changer is very small and is designed to be used in either a horizontal or vertical position.

The KDC-7002 (RRP $859), KDC-6002 (RRP $779) and KDC-5002 (RRP

Improved MiniDisc Walkman models

Sony Australia has released two new MiniDisc (MD) Walkman models which are smaller, lighter and more convenient than the units introduced last year. The pocket-size models feature more sophisticated circuitry and other improvements which allow users to enjoy digital stereo anywhere, any place and at any time. Sony has also focused careful attention on making the units as user-friendly as possible.

The size and weight of the MZ-R2 and MZ-E2 have been substantially reduced through the successful development of several key technologies, including miniaturisation of the digital signal processing ICs and a new dual-axis actuator for the objective lens. The result has lead to the MZ-E2's optical pick-up mechanism being reduced by 30%, giving an overall slimmer profile.

The new models can draw power from four sources: the extremely energy efficient, rechargeable lithium-ion battery, which is supplied, three AA-sized alkaline batteries, the supplied AC adaptor or an optional car battery using a separate cord. Besides saving space and weight, the new lithium-ion battery extends playing and recording time.

The MZ-R2 and MZ-E2 are the first MiniDisc models to use this battery, which was developed originally for Sony's advanced 8mm camcorders. The battery can also be used with regular alkaline batteries to almost double playback time and users can recharge the battery while listening to music, with the supplied AC Adaptor/Floating Recharger.

The MZ-R2 recording Walkman is about 40% smaller and 45% lighter than its forerunner, yet offers 30 minutes more playback and recording time. It measures 84 x 29.9 x 106.8mm and weighs only 310 grams, including the rechargeable battery.

The MZ-R2 can digitally record onto a MiniDisc from almost any source. It has a stereo microphone input for live recordings, a digital optical line-in for CD DAT or any analog source, as well as a stereo line-out for connection to other components or systems.

The MZ-E2 measures 74 x 18.5 x 106.8mm and weighs only 205 grams, including rechargeable battery, making it one of the world's smallest, thinnest and lightest MiniDisc players. Never before released in Australia, it features a longer battery operation and a larger, 10-second, shock resistant memory.

To make this pocket size model as convenient as it is small, Sony developed a remote control with a six character, single line, dot matrix LCD readout connected to the headphone cord. With it, users can control all functions without removing the MZ-E2 from purse or pocket. The display can scroll album names, artists, song titles and other information.

Sony's MZ-R2 and MZ-E2 carry an RRP of $1499 and $1199 respectively.

New 'Technics' Mini hifi system

Panasonic Australia has launched a new Technics mini hifi system. Known as the SC-CH515, it is a separate component system with additional tape or hifi video cassette recorder input/ouput connections, plus auxiliary input for laser disc.

The SC-CH515 also has a motorised dual cassette deck with auto-reverse and Power Loading System. For Karaoke enthusiasts it has a microphone input and three sound field modes — disco, hall and live. Up to 30 memories can be set in the stereo tuner, which has FM/MW/LW bands.

The new system also includes a three disc CD player which allows the user to play one disc while changing the other two, giving continuous entertainment. This unit features the 'MASH' single-bit conversion system for superior sound quality. It also has random and repeat play functions.

The SC-CH515 has 50W RMS x 2 output and a three way speaker system with a 140mm woofer. It is available from electrical retailers and hifi specialists for a recommended retail price of $1699.

$659) and the KDC-C602 Multiple CD player ($699) are covered by a three year parts and labour warranty. For further information on these and other car audio products please contact Kenwood on (02) 746 1888.

New Dali 850 speaker system

Scan Audio has released the Dali 850 speaker — in many ways the logical successor to the very popular Dali 18. Dali 850 employs a similar driver complement (dual woofer/midrange/tweeter system), with the two bass drivers having a nominal diameter of 22.5cm, and an effective cone area of 224 square centimetres each.

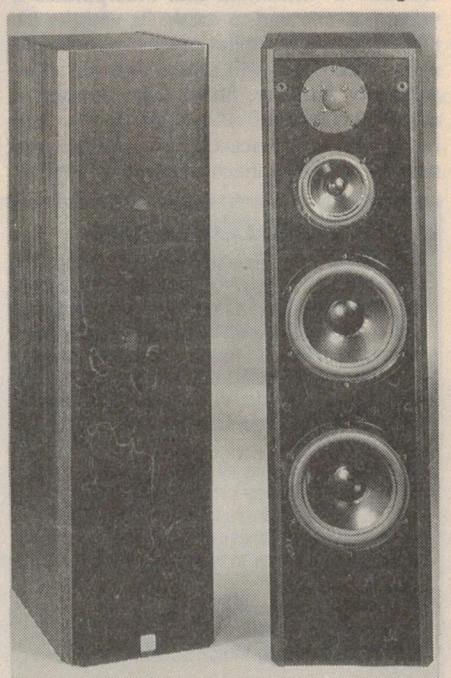
Two smaller bass units can perform well up into the midrange region, where larger drivers enter break-up mode and become quite directional. The relatively narrow diameter of the drivers allows for a slim front baffle, which as well as improving stereo imaging, is generally more domestically acceptable for the average contemporary household.

The twin bass drivers, a brand new design from Vifa in Denmark, make use of much modern technology. Features include a 50mm voice coil, wound with extremely high temperature wire, which contacts the diaphragm over a large area; a cone assembly made of a very stiff, but light conical paper material, chemically treated to dampen unwanted resonances; and a rigid die-cast chassis carefully designed with narrow ribs, to avoid air reflections back onto the driver cone.

The Vifa midrange driver used in Dali 850 is also a new design, and shares much of the same technology as the bass drivers. The same rigid die-cast chassis, high damping rubber surround, and high temperature voice coil wire are used. This 14cm driver, with an effective cone area of approximately 80sq cm, is said to have outstanding measured frequency response and a smooth impedance curve.

Dali 850 uses a 25mm fabric dome tweeter, chemically coated on the inside of the dome. The pole piece of the driver is a carefully shaped hollow design which allows the passage of air through to the damped chamber on the back of the magnet. This is done to avoid reflects of air back through to the dome, which would otherwise cause colourations. The tweeter is fitted with a substantial magnet assembly, which adds to efficiency and dynamic range.

For further information on the Dali 850 circle 181 on the reader service coupon or contact Scan Audio, 52 Crown Street, Richmond 3121; phone (03) 429 2199.



Otari debut MiniDisc recorder/player

The new Otari MR-10 series MiniDisc Recorder/Player is designed for high reliability with professional features. The MR-10 series is eminently suitable for music programs, jingles and station IDs in broadcast; music and effects for theatre and stage performance; service announcements, background music and tourist information in public environments, exhibitions and theme parks; and archiving and playback of sound effects at film and video post production studios.

Two models are offered — the MR-10 MD Recorder, featuring high performance digital audio record and playback with sophisticated editing and titling facilities, and the companion MR-10-P player.

Both units are supplied with dedicated, full function remote controls — the CB-159 for the recorder, including a QWERTY keyboard for titling, and the CB-160 player remote control.

Both MD units employ the latest generation Mini-Disc (MD) recordable, magneto optical digital medium, offering up to 74 minutes of high quality stereo program comparable to compact disc. With its protective housing measuring only 72 x 68mm and 5mm thick, the disc is read by a non-contact laser, similar to a CD, and is claimed to be just as impervious to magnetic fields and degradation over time.

For further information circle 182 on the reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975-1211. ❖

YAMAHA'S VL1 VIRTUAL ACOUSTIC SYNTHESISER

An acknowledged pioneer in the area of music synthesisers, Yamaha has now made what people believe represents a major leap forward in this technology with its 'virtual acoustic synthesis'. This month our reviewer Louis Challis was able to hear the new Yamaha VL1 Virtual Acoustic Synthesiser in action, and judge its significance for himself...

Like many children, I was enthralled by a piano player in the guest lounge of a country hotel where I holidayed in my youth. I guess it was the automation of the piano and the negation of the skilled human involvement that initially attracted me. Of course, playing that piano required considerable foot action, and specifically to activate the pneumatic drive pedal system. That distraction made me oblivious to many of that piano player's otherwise obvious deficiencies.

When I later learned to play the piano, I began to realise that the music produced by that first piano player was not true to life, as it lacked *expression*. Many years later, when I came to purchase my current piano player, I resolved that I would only purchase one whose pre-recorded rolls incorporated full expression. (Although you may not realise it, there were two different types of piano player produced in the early 1900's: those that reproduced with either all or some of the original player's force expression, and those that just reproduced the piano sounds without any expression.)

Following my youngest son's purchase of his first Yamaha synthesiser, I became somewhat disdainful of the music that he and his synthesiser produced. Once again the music or sounds produced by his synthesiser lacked expression. Although he and it produced plenty of sound, that sound was not as pleasing to the ear as that produced by his piano playing, or by other orchestral instruments with which I am familiar. I guess I had started to build up an antipathy to synthesised music...

Earlier this year, whilst sipping a glass of orange juice and munching on a sushi at the Gala opening of Yamaha's Sydney Music School, I was introduced to the Managing Director of Yamaha Music Australia, Sam Takeuchi, and to Steve Lincoln-Smith who Yamaha had specially flown up from Melbourne for the Gala evening.

Steve wasted little time, and directed me into a marquee which had been thoughtfully set up at the front of the building. At one end of the marquee an impressive Yamaha PA speaker stood proudly next to an unusual synthesiser which caught my attention. It was obviously new, it was obviously different, and I guessed (correctly) that this might be the reason why Steve Lincoln-Smith had herded me in that direction.

Steve confided in me that what I was about to see and hear might dramatically change my outlook and my perspective on professional music. He went on to explain to me in considerable detail the underlying concepts and attributes of the system that he was going to demonstrate to the gathered audience of visitors a little later in the evening. It was as well that he did, because had he not done so, I doubt very much that I would have stayed much longer.

Steve asked whether I was familiar with the shakuhachi, which is a simple slotted Japanese flute. Fortuitously, I *had* previously heard the shakuhachi and had admired its music during a live demonstration in Japan more than a decade ago.

Now the shakuhachi is a rather primitive woodwind instrument that incorporates a venturi at one end to create its whistle. It's played in a very similar manner to a simple school recorder, with which you are most probably familiar. Steve then popped a mouthpiece connected to a plastic pipe into his mouth, and proceeded to reproduce the sounds of a shakuhachi, complete with all the relevant pressure and embouchure effects, with which I was well familiar from my previous auditory experiences with real shakuhachis.

"Amazing!" I said. "This is obviously no ordinary synthesiser — what gives?"

Steve proceeded to demonstrate how the Yamaha VL1 Virtual Acoustic Synthesiser can do amazing things that no other synthesiser has ever done before. He played the bagpipes for me, then the saxophone, the trombone and even a violin. He did all this with a degree of realism which initially defied logic. A quarter of an hour must have passed in a flash, then in came the rest of the august gathering, for their obviously longer but less dramatic introduction and speeches which were made by the dignitaries from Yamaha Australia. Finally the evening's entertainment was ably presented by Steve Lincoln-Smith, who was clearly Yamaha's 'piece de resistance' that night.

My parting comment to John Fahey, Yamaha's Sydney Manager was, that although the assessment of a synthesiser would not normally be considered as the basis for one of my review articles, the Yamaha VL1 Virtual Acoustic Synthesiser was so revolutionary, that I would suggest that the Editor should carefully consider its merits.

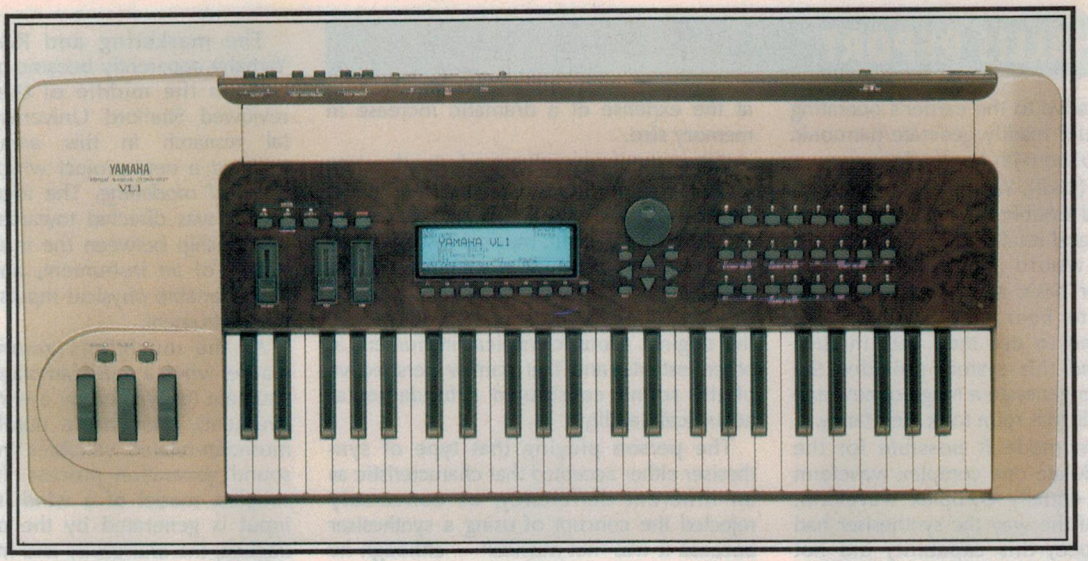
Demo CD available

Any of our readers whose interest in the Yamaha VL1 Virtual Acoustic Synthesiser has been aroused by Louis Challis' review will no doubt be keen to sample its impressive capabilities for themselves. And this is now very easy, as Yamaha Music Australia has just produced a VL1 Demo CD featuring Steve Lincoln-Smith at the keyboard and mouthpiece.

To obtain your copy of the Demo CD, send a cheque or money order to the value of $6.00, to the address below. This price includes postage and handling. The address to send your order to is:

VL1 Demo CD,
Yamaha Music Australia
PO Box 268,
South Melbourne, Victoria 3205.

Alternatively, if you wish to pay by credit card, contact Steve Lincoln-Smith of Yamaha direct on (03) 699 2388.



Some two weeks later, after the Editor had given his approval, Yamaha flew Steve Lincoln-Smith back to Sydney yet again, to demonstrate the VL1 in my office. Here, with the assistance of my staff, we could 'suss out' what it does, and how it works.

When Steve arrived at my office, he initially provided a historical background on Yamaha's development of amateur and professional synthesisers. Now as you may well realise, Yamaha were not the first firm to develop a synthesiser; that honour undoubtedly belongs to some pioneering gentlemen in America at the Bell Telephone Laboratories, and subsequently other people who developed the Moog synthesiser. The best example of a Moog synthesiser is incorporated on a Telarc CD entitled 'Switched On Bach'.

The early synthesisers produced by Yamaha, as typified by their CS5 and CS10 (and later the CS20M and CS40M), were basically analog synthesisers in which there were one and later two oscillators, with associated filters, envelope shapers and voltage controlled amplifiers to produce the typical synthesiser sounds.

Those synthesisers incorporated a patch board, which was basically a rotary encoder, which when judged by today's standards were fairly primitive, even though they were quite functional. Musicians and the developmental team at Yamaha were reasonably happy with what they had created, but they delved further seeking a superior sound. They ultimately came up with the PCM or pulse code modulation system, which is very popular as a basis for drum sounds.

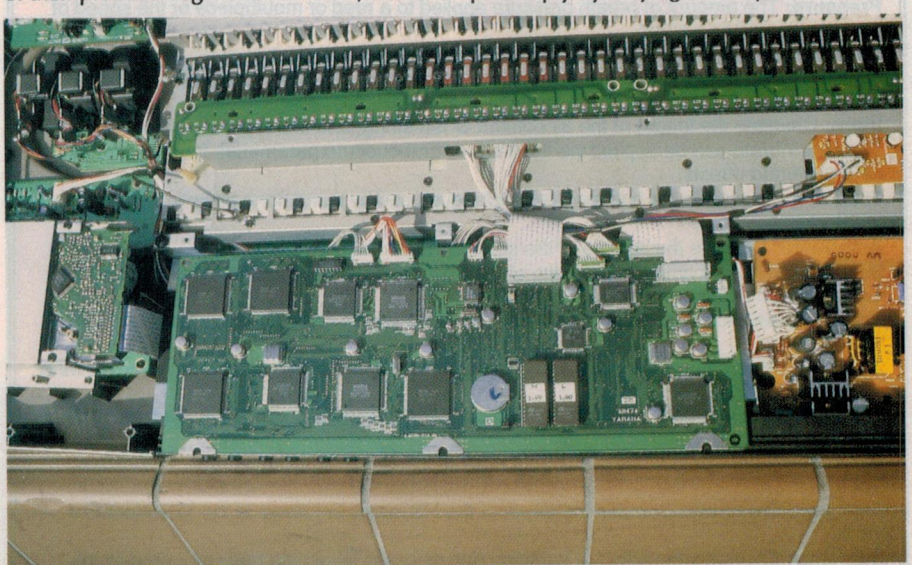
The PCM system was the forte of the early Yamaha home organs, and such instruments proved to be their principal market at that time. Slightly later, Yamaha became aware of the work of John Chowning at Stanford University (California). John was working with vibrato and what he was observing was what could be achieved in terms of new artificial sounds, in terms of exploring the range of options offered by varying the vibrato content. John Chowning wasn't really interested in working on synthesis as such, but he started examining the relationship between two waves, where one of those waves is a carrier, and the other wave is the modulation or modulator component. He termed this field of sound reproduction FM Synthesis.

When you evaluate those sort of relationships on the basis of their FM or frequency modulation characteristics, you can develop some rather interesting relationships. More significantly, you can develop some basic mathematical algorithms which simply define the characteristics of the reproduced sound. Obviously, that is precisely what John Chowning did, and the results of his work were sufficiently impressive for Yamaha to buy the new technology. Simultaneously it ensured that John Chowning should patent that technology.

Yamaha moved away from analog synthesisers into FM synthesisers. The flagship of their product range was their DX7, tens of thousands of which were sold worldwide. The popularity of the DX7 was phenomenal. The primary reason for its overwhelming sales success was because the sounds that it created were radically different, and perceived to be exciting; it was not as a result of the ease with which it could be programmed (as I would have thought).

Synthesisers like the DX7 employ two or more wave forms which are mixed to produce the complex sounds. You can have a harmonic series built up by modulating one sinewave with another. Yamaha developed 32 basic algorithm patterns using six oscillators (which Yamaha describe as operators), whose functional usage may be defined as being either a 'carrier' or a 'modulator'.

The operational rules were quite simple. You could set the carrier frequency at any point in the audible frequency range, and similarly for the modulator. You could thereby control the modulation index of the output simply by varying the output level of the



During the brief time that Louis Challis had access to a sample VL1 synthesiser, he took the opportunity to remove the cover and take this picture of the 'works'. As you can see there's quite an array of LSI chips inside.

modulator relative to the carrier's operating level. You could readily generate harmonic products up to the 64th harmonic.

In the DX7 (MkII), Yamaha took considerable time and trouble to formulate mathematical rules and relationships whereby the synthesiser would generate 16 basic waveforms (or basic sounds) that the user might wish to hear or use. Of course musicians tend to use their ears in such situations, and this system provided the wherewithal to generate a range of new and unusual sounds that soon took their fancy.

This system made it possible for the player to modulate one complex waveform with another equally complex waveform, but because of the way the synthesiser had been developed, this capability did not necessarily offer the user any great perceived advantage.

The marketplace's perception of what it wanted soon changed once more, deciding that because the level of programming required to achieve optimum results with an FM-based system was too demanding, then a PCM type product prospectively offered better performance with less complexity.

A PCM system stored a basic waveform in its ROM (read-only memory). The output of the waveform generator was followed by a filter which modified the envelope to provide additive effects. This functional approach initially created some problems for Yamaha, and the early 12-bit PCM waveform generators did not achieve all the functional goals that Yamaha had hoped they would.

When Yamaha subsequently moved into PCM generators with 16 bit samples, the results were clearly superior, but obviously at the expense of a dramatic increase in memory size.

What the users observed, in the late 1980's, was that the sounds that were being stored in the synthesiser's ROM were representative of a specific musical instrument at one instant of time. Those sounds were not necessarily representative of the dynamic characteristics of the sounds produced by the original acoustic musical instrument at other instants, and that narrow perspective of the sound constituted a fundamental acoustical liability.

The person playing that type of synthesiser either accepted that characteristic as an inherent deficiency, or conversely rejected the concept of using a synthesiser because it was 'not musical' — although he or she may have been playing the instrument in what would otherwise be perceived as being 'in a musical way'.

Of course, many musicians took the view that for the instrument to be classified as a musical instrument it should react to the way in which the musician plays it, as opposed to the musician controlling only some parts or facets of the operation of that instrument.

The inherent logic underlying that viewpoint assumed major significance in Yamaha's perspective of where they were going, particularly as the company had been essentially a musical instrument manufacturer for almost a century.

At about this time, Yamaha developed their first electronic reproducing piano player, the Disk Clavier, and the incorporation of full expression in the replay constituted a fundamental, and important element in that development.

TABLE 1: THE CONTROLLERS

Pressure: The amount of breath pressure applied to a reed or mouthpiece or the speed of the bow applied to a string.
Embouchure: The lightness of the lips against the reed or against each other. In a string instrument voice Embouchure corresponds to how strongly the bow is pressed against the string.
Pitch: Changes the length of the air column or the string, and thereby the pitch of the sound.
Vibrato: Vibrato can be applied via the Pitch or Embouchure parameters for exceptionally natural vibrato effects.
Tonguing: Simulates the half tonguing technique used by saxophone players by damping of the reed.
Amplitude: Controls the volume of the sound without varying timbre.
Scream: Drives the entire system into chaotic oscillation, creating effects that can only be achieved with physical modelling technology.
Breath Noise: Adds breath noise. The sound of the breath noise itself can be varied over a wide range.
Growl: A periodic pressure modulation which produces the 'growl' effect often heard in wind instruments.
Throat format: Controls the characteristics of the simulated player's lungs, trachea, and oral cavity.
Dynamic Filter: Controls the cutoff frequency of the Dynamic Filter in the VL1 Modifiers block.
Harmonic Enhancer: Controls the depth of the Harmonic Enhancer in the VL1 Modifiers block.
Damping: Simulates the effect of damping due to losses within the body of a wind instrument or in a string due to air friction.
Absorption: Simulates the effect of high frequency loss at the end of the air column or string.

The marketing and R&D people at Yamaha apparently became quite introspective. In the middle of the 1980's they reviewed Stanford University's fundamental research in this area, and they initiated a new project which they termed *physical modelling*. The focus of their research was directed towards assessing the relationship between the musical or sound output of an instrument, and the player's multi-variable physical inputs when playing that instrument.

As the musicians amongst you will realise, when a musician plays a musical instrument (as typified by a wind or string instrument), there are a number of critical musician-related variables involved in the sound generation process. If we take the simplest model of a wind instrument, the input is generated by the player's lungs, trachea, the oral cavity and most importantly by his or her lips.

In the case of a string instrument, the variables come as a result of the player's arm movements, the extent of bow resin, the applied pressure, angle of contact and velocity of movement — as well as related finger pressure on the fingerboard in the case of a violin, viola, or cello. Each of these elements constitutes an integral and all-too-frequently critical component in the sound generation process.

Yamaha's research was directed to assessing the significance and the physical inter-relationship between the musician's control of the sound generation process for typical wind and stringed instruments. In effect, what they derived were the dynamic transfer functions for each of the elements, which are listed in Table 1. They provide the basis for a musician to generate a range of sounds as typified by your favourite trombone, saxophone, flute, bagpipes, violin, cello, and a multitude of other generally similar instruments.

As you will appreciate, if you blow hard on a flute or a recorder, then the frequency of the sound produced may jump by an octave or even two, as a result of harder blowing. Likewise, depending on how hard or fast you bow on a violin, you can produce an entirely different sound.

The conventional PCM or FM based synthesiser will neither respond nor duplicate the characteristics of an acoustical instrument in that way. It simply does not matter how hard or how fast you press the keys; you get one sound, and only one sound.

Yamaha devoted considerable time, effort and of course research funds for a group of researchers at their acoustics laboratory at Hamamatsu in Japan, firstly to derive the transfer relationships (and in effect the equations) for a wide range of wind and string related instruments, and thereafter in the programming of a digital microprocessor based instrument, which integrated the results of that research program.

Enter the VL1

Yamaha's VL1 Virtual Acoustic Synthesiser is the first synthesiser which dis-

cards the archaic PCM or FM type pre-programmed synthesis method, and replaces it by a true physical modelling. The instrument keyboard has 49 keys, and provides both velocity and channel pressure sensing.

The memory contains 128 voices in a battery-backed RAM. The physical modelling is based on a duophonic system, with independently programmed elements which include pressure, embouchure, pitch, vibrato, tonguing, amplitude, scream, breath noise, growl, throat formant, acoustical damping, sound absorption, plus real-time control of a harmonic enhancer and dynamic filter. The envelopes of pressure, embouchure/pitch, vibrato, growl and the amplitude filter are all programmable.

The operating features provide two programmable modifying wheels, two programmable sliders, and a pitch/bend wheel.

The special effects provided include a flanger, a pitch shift, controllable distortion, three delay times and eight levels of reverberation. The VL1 incorporates a five-band equaliser, edit-recall commands, which provides the ability for the musician to exercise a significant degree of control over the final timbre of the sound that is produced. The modifier block consists of five sections which are listed in Table 2.

In order to exercise the primary dynamic control, a type BC2 breath controller and a model FC7 foot controller are provided for the musician. Without these, and more specifically without the BC2, the musician's ability to exercise functional control over the VL1 are irretrievably impeded.

Steve Lincoln-Smith demonstrated that a piano keyboard produces a sound which is determined in part by how hard you hit the key. With the first generation of synthesisers, that could not be achieved. With the subsequent generation, Yamaha came up with the concept of a pressure-sensitive keyboard, and that relied on exercising control over one of the filters in the sound generation chain. That was subsequently upgraded to exercising control over the envelope.

That mode control is of course quite different from what happens in an acoustic instrument, which vibrates in a different harmonic way depending on the amount of force applied. The only real way to duplicate the characteristics of a real instrument is to have a real-time computer emulate those quantifiable physical/acoustical characteristics.

Yamaha Corporation put a team of extremely talented young engineers (and musicians) onto the task of developing the VL1. They included illustrious names like Michimoto, Matsuda, Kakashita, Komono, Suzuki, Tanagouchi, Yamazaki, and Charlie, whose names are recorded for posterity in the resident software of the VL1. These august gentlemen are sufficiently proud of their achievement to ensure that their names may be examined by the VL1's purchaser.

This is the first time that I have ever seen a product where you are able to find out from the product itself who designed it. Of course it should be noted that this information is not instantly accessible; but it is there nonetheless.

TABLE 2: THE MODIFIERS

Harmonic Enhancer: The Harmonic Enhancer allows you to manipulate the harmonic structure of the sound to the extent that you can create radical timbral variations within the current instrument 'family' (e.g., saxes).

Dynamic Filter: The dynamic filter has selectable high-pass, bandpass, band elimination, and low-pass modes, and a 'wet/dry' balance parameter which allows delicate variations in the degree of filtration applied.

Frequency Equaliser: This is a five band parametric equaliser with frequency, Q (bandwidth), and level control. The equaliser also has pre-EQ high and low-pass filters as well as key scaling capability for precise response control throughout the instrument's range.

Impulse Expander: The Impulse Expander works in conjunction with the Resonator, described below, to simulate the effect of an instrument's resonant cavity or sound box. It can also be used to simulate the acoustic environment in which the instrument is played.

Resonator: While the Impulse Expander and even the Harmonic Enhancer tend to give the sound a metallic quality, the Resonator produces a more woody resonance effect.

The basic idea

What the VL1 does is to integrate advanced DSP technology into a number of LSI chips, which then perform tasks and activates phenomena which have not previously been considered part of the DSP domain.

The first characteristic is your ability to change the size of the resonance cavity of the wind instrument that you are blowing. That is a very fundamental acoustical parameter. Thus by way of example, we can have a model of a saxophone, which integrates a reed of the correct size and a suitable mouthpiece, and provides a basic building block on which to model the instrument.

The length of the tube, the materials from which the tube is constructed and the resonance chamber at the end of the tube are all variables as well. That is how you produce a tenor, alto, soprano or bass saxophone.

Now a clarinet has the same fingering, but has different tonality, a single reed, shorter length of tube and a different density of material. The resonance frequencies and resonance characteristics are quite different. The physical model for the reed, and more significantly, its electro-acoustic model react in real time to generate a harmonic series which are determined by the player of the instrument. In the VL1 model, we can also change the length of the body in real time to vary its characteristics.

What Steve Lincoln-Smith proceeded to demonstrate to us was that when you blow into a saxophone, you have various components — including a white noise component, a key tract in pitching the music which you can hear move up and down the scale as you blow harder or softer. The reed's characteristics are fundamental, and are readily capable of being quantified in terms of the transfer characteristics.

By means of the BC2 breath controller, he demonstrated to us the ability to pitch the frequency response through under-blowing or over-blowing, in order to vary all of the nuances of the reed. As Steve explained, no two notes played by a musician ever sound precisely the same on a wind instrument, because of the variables involved in producing that sound.

There are a myriad of elements that determine the sound, the most important of which are pressure, embouchure, pitch, vibrato and tonguing (see Table 1). The characteristics of the sound are obviously further modified by the associated physical characteristics of the instrument concerned. In the case of a real instrument, those elements are fixed; but in the case of the VL1 the player is able, almost at will, to vary those parameters — and this is where the term *Virtual Acoustic Synthesiser* starts to take on a new meaning...

As Steve explained, say you take a French Horn and give it to a monkey, but don't tell him how to intonate. Instead you show him how to 'mmm mmm' and make the buzz tone. The intelligent use of intonation, and the related critical techniques like tonguing produce a dramatic change in the quality of the sound. The audible differences may range from a monkey playing the horn at one end of the spectrum, the hesitant playing of a young teenager in the middle, and an experienced professional musician at the other end.

The same basic musical parameters and characteristics apply to the cello, as any experienced string instrument player will tell you. The way in which you bow your stroke, the way you hold your wrist, the applied pressure, and the velocity of the bow across the strings all interact to produce different sounds and audible characteristics. Obviously, in the case of the cello, peripheral factors like the amount of resin on the bow and the shape, resonance and damping characteristics are equally important.

That's not all!

The VL1 provides the wherewithal for the experienced musician (one who understands these characteristics in the real world), to reproduce identical characteristics by varying the pressure and tonguing characteristics on the BC2 breath controller so that a novice musician like you or me would close our eyes, and have difficulty in knowing the difference. That of course is exciting. But as I soon discovered, the description Virtual Acoustic Synthesiser means

THE CHALLIS REPORT

much more than that. A computerised instrument that incorporates a set of rules can do much much more.

To take a physical example, Steve then proceeded to demonstrate a virtual instrument in which he combined a trumpet mouthpiece which was then attached to a violin body, on which the strings were still attached. Now in the real world that is not possible, because there is simply no way of blowing into a mouthpiece to vibrate those strings. But in the virtual world of the VL1, that is precisely what you can do. As the mouthpiece follows a set of rules, and you are able to modulate the characteristics of the string instrument so that it will follow the rules of that mouthpiece.

Steve proceeded to demonstrate an instrument that sounded not unlike a harpsichord, but which displayed characteristics totally unlike any harpsichord that we had ever seen or heard.

I soon came to appreciate that to produce the exciting, and frequently incomparable new sounds which Steve produced with the Yamaha VL1, requires considerable skill that comes in part from comparable practice. In order to optimise or produce great sounds from the Yamaha VL1, you have to be a consummate musician already. That doesn't mean to say that you couldn't start learning to play the VL1, and produce reasonable sorts of sounds, but rather that your music is unlikely to be outstanding if you are not already a serious, dedicated and competent musician.

Steve Lincoln-Smith proceeded to display the differences in quality and timbre of sound that a young musician would produce when compared with say, the type of music that he would expect a 65-year-old guitarist to produce at the Hornsby RSL Club. He expounded on the differences in sound quality resulting from changes in the thickness of a reed, variations in the pressure transfer characteristics of the reed, and the more subtle changes associated with the tonguing of the mouthpiece.

Steve then went on to display the changes in acoustical characteristics that can be produced by varying the dimensions and materials of the tube element (or the rest of the instrument), connected to the mouthpiece and reed.

Then to my surprise, he proceeded to show us how the VL1 can be programmed to produce differences in sound corresponding to a change of the power amplifier, or even changes in the brand or type of loudspeaker that you might wish to connect to that designated amplifier.

The sun was already low in the sky by the time we got around to opening up the VL1 to see what makes it tick. Obviously, a brief examination of a series of large scale integrated circuits (LSI chips) on a gold plated printed circuit board doesn't tell you all that much about the equipment.

The Japanese handbook, although particularly well illustrated, is positively inscrutable to a person who neither speaks nor reads Japanese. The English handbook is obviously easer to understand, but apart from beginning to explain the basics, it requires the combined skills of a good musical background coupled to the desire and ability to extract its relatively complex information.

Notwithstanding my limited musical training, it was obvious that the designers and the factory staff had applied considerable care and attention to details.

I questioned Steve on the exquisitely veneered upper central panel. His response was not unexpected: Yamaha have been in the business of making pianos and quality (if not the highest quality) musical instruments for more than a century. Many of their finest musical instruments, and particularly their pianos and organs, are fabricated from timber.

In summary

The VL1 is simply not just another synthesiser; this is the first synthesiser that is capable of duplicating all the critical functions and musical elements that we have come to expect from a true musical instrument. Unlike other musical instruments which generally perform only one task or one group of tasks, the VL1 is already capable of duplicating the characteristics of a large number of musical instruments. More significantly, it does this with a degree of panache which no other musical instrument currently matches.

I am sufficiently impressed by the performance of the VL1 to state my view quite openly (and positively), that the VL1 is the start of a 'new wave'. Its development will alter our perception of serious and ultimately orchestral music. Its development will result in a significant change in how musicians perceive their broad interaction with musical instruments, and where and how those instruments should be used.

Obviously, this is one instrument that you simply cannot go down to your local hifi shop and audition in the same way that you could the majority of other items of consumer equipment that I have previously reviewed.

Notwithstanding, if you are sufficiently impressed by the concepts that I have attempted to explain here, then I suggest that it will be worth your while to send for the demonstration CD (see box). This will ensure that you really do appreciate and understand the audible implications of this exciting technical advance.

The Yamaha VL1 Virtual Acoustic Synthesiser measures 914mm long, 380mm deep and 105mm high, and weighs 12.5kg. It has a recommended retail price of $7495. Further information is available from Yamaha Music Australia, of 17-33 Market Street, South Melbourne 3025; phone (03) 699 2388. ❖

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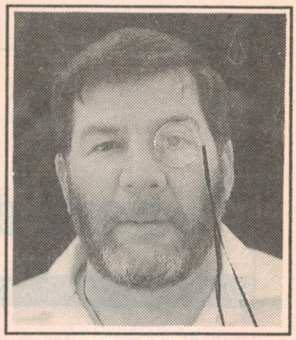
Moffat's Madhouse...

by TOM MOFFAT



Is Morse code really dead?

Oh boy! Are we going to rattle some cages today. Good old Morse code has become a very touchy political issue among radio amateurs, and moves are afoot to abolish Morse in commercial services as well. But, despite official efforts, Morse just refuses to lie down and die.

The anti-Morse code forces put a very valid argument that Morse has been superseded many times over by modern technology. Back in the 'good old days' the only way to send messages over radio or wire was with dots and dashes and clickety-clacks. But then somebody figured out how to transmit voices, and the writing was on the wall for Morse.

On radio, amplitude modulation (AM) came along, and then single sideband (SSB), and these provided high-quality voice transmission. For a while there was no provision for sending written communication by voice, other than by taking notes of what the other end said. But this gap was filled by radioteletype prior to World War II, and after many years of advancement, computerised packet radio transmission in its many forms became the standard.

All this stuff was supposed to be replacing Morse code. No longer was it necessary for a radio operator to spend hours and hours slogging his way to proficiency in this arcane language. If the operator could bang away on a typewriter keyboard, and read off a sheet of paper, then that was good enough.

But wait! What are all those strange noises on the 8MHz, 12MHz and 16 MHz marine radio bands? Sounds like dots and dashes. But Morse code is dead! Well, don't tell those thousands of ship and shore operators still tapping their keys...

Why, in this modern day and age, are ships still using Morse? This is probably best explained by the old saying, "If it ain't broke, don't fix it". Current official thinking is that maritime services (read 'ships at sea') should all be switching over to satellites for their communications. A special satellite service called Inmarsat has been provided for this purpose. However for ships to use satellite communications, they must be equipped with a miniature version of a satellite earth station; and these don't come cheap!

For large ships of big companies, such as bulk ore carriers or the QE2, the cost of a satellite communications system is a drop in the bucket compared to the overall cost of the ship. Once the shipboard station is installed, the satellite lets the ship's operators or passengers make calls over a regular telephone, just like from home — although the connect charges are pretty stiff at the moment. You can also send faxes and data.

But for smaller ships of the 'tramp steamer' class, and these would comprise the majority of the world's shipping fleet, the cost of going to satellite could very well mean the whole ship is no longer financially viable. So they stick with their HF radio — SSB voice when conditions permit, but for the most reliable long range communication, Morse is still king.

The smaller ships concept applies to smaller countries too. The big industrial powers can certainly go satellite without blinking an eye, but all you have to do is listen around on the maritime HF bands and you'll hear squeaky little Morse code signals coming out of third-world countries like Costa Rica and Guatemala. These countries are running coastal stations for the benefit of their shipping, and if the ruling came down as 'satellite or else', they'd simply have to shut down, leaving their ships to sink or swim.

Why, then, do you hear Morse code coming from coastal stations in places like San Francisco and Honolulu and Tokyo and Australia? I suspect there are two reasons. One is that if these stations are to service the small ships they must speak their own language: Morse code. The other reason is military. A lot of coastal stations are connected with navies, and at time of war there's every chance that satellite systems such as Inmarsat will be destroyed. How do you communicate then? Morse code...

One big advantage of doing away with Morse code is that radio operators no longer need to learn the blasted language! In fact you don't really need radio operators anymore. With the new satellite services, the Captain on the bridge of a ship need only pick up a telephone handset, punch a couple of buttons, and he's chatting on the phone with home office back in London.

This is a shame, really, for us electronics types, because the profession of 'radio operator' could soon become a thing of the past. In my youth, in fact, I very nearly took the plunge. A life at sea beckoned — ship's radio officer (an *officer*, with a nice spiffy uniform, an elegant life and the pick of the lovely lady passengers as we cruised to Club Med or Bermuda!

At that stage I had the technical qualification: a First Class Radiotelephone Operators Permit, which is the highest certification issued by the US government. One must hold this to be employed as a chief engineer at a radio or TV station, or to be in charge of any type of broadcasting transmitter.

With this licence, and 25 words-a-minute Morse, you qualified as an apprentice ship's radio officer. And after one year's experience, you could lord it over your own radio room. I had a ham licence, and good 15 words-a-minute code, so that idea was well within reach. But I somehow wound up in Australia instead.

However maybe there's a place for radio operators yet. I recently saw a television documentary on the QE2, with a BBC camera team travelling on an Atlantic crossing. This ship has got to be the ultimate in technical sophistication, so I was somewhat surprised to see scenes in the radio room, and a 'proper' radio operator using Morse to communicate with a station with the callsign 'DAM'. Being able to read Morse code

does have its advantages, even when watching television.

Another instance was in the film *A Night To Remember* about the sinking of the Titanic, also shown recently on television. Here there were lots of scenes in the radio room, filled with all the kind of gear appropriate to the early 1900's. There was an old spark transmitter making buzzing sounds, instead of the pure tones we are used to today. And you could hear phrases like 'struck — iceberg — sinking', nicely sent in Morse. You could see the hand of the actor playing the radio operator, obviously tapping out the signals we were hearing at around 15 words a minute. That means the producers must have been able to find an actor who knew Morse code. Fascinating!

When I went to the Antarctic I was also pleased to see that Morse code was alive and well there. In 1983, pre-satellite, the stations had big HF radio systems which transmitted information between stations and head office in Australia — mostly over radioteletype. These same stations could also be used on SSB to contact the OTC station in Sydney for phone calls home. But from time to time the radio operators would drag out their Morse keys for a bit of inter-station chit chat. This was supposedly for 'fun' and to keep in practice, but it also meant they could pass lots of scuttlebutt without fear of being overheard. Or so they thought...

Same system applied on the ship, the *Nella Dan*. Radioteletype was used for official traffic, but the radio operators reverted to Morse code for personal chats with their friends back at head office in Denmark. They apparently forgot that certain members of the ship's company might just have a personal shortwave receiver, and might also have a knowledge of Morse code. (Fascinating!)

So you can see that Morse code still has its uses. In the Antarctic 10 years ago, radioteletype was fine when radio conditions were good, but it didn't have a hope when there was noise or fading. Voice would then work for a while; but when the chips were *really* down, Morse code was the only option.

Of course, now satellites have fixed all the problems of lousy signals and noise and fading, and circuit reliability for telephone and data is now pretty close to 100%. That is, until the satellite fails. What do you do then? Try Morse code, perhaps. Astute operators are still hanging onto Morse as a backup, if nothing else.

Within this context, then, rages the current battle in amateur radio. Should Morse code be a requirement for an amateur license? If you look at the amateur scene as it is today, the most obvious answer is a resounding NO! Today's amateur operator communicates almost entirely by voice, with occasional forays into data and picture modes. Today's amateur operator uses equipment which was purchased ready-to-go, and if it goes kaput, there is a friendly factory service department to fix it up. The term 'button-pusher' is used disparagingly, but if we are perfectly honest, we know that's exactly what we are.

Most store-bought HF transceivers still have a connection for a Morse code key, and a 'CW' operating mode. And if you listen around near the bottom of the bands you'll hear people joyfully using these facilities. Common thought is that they are old men, but experience has shown that this isn't necessarily the case.

I had a big surprise once when I personally met one of the 'big gun' amateur Morse code operators. This guy had won just about every Morse award there was, and he was all of 24 years old. As well as his ham stuff he was into skiing and sky diving, rode a Harley-Davidson, and had a most impressive collection of girlfriends. Old man, indeed!

There is still a strong contingent that feels Morse code should remain compulsory for amateur licences. The original Morse requirement came from the time when it was thought a ham was expected to step in and improvise a communications system when some disaster destroyed normal communications. The simplest way from a technical point of view was to haywire a Morse code transmitter.

I remember contests at ham conventions where each participant was given a soldering iron and an old mantel radio and told to turn it into a transmitter. The first person to get a Morse code signal out of the converted radio was the winner. Most achieved success in well under an hour.

Nowadays, with relaxed licence requirements, I doubt few people would have the technical knowledge to make an old radio into a transmitter. Of course there is a definite shortage of old valve mantel radios these days, and I suspect the job would be a lot harder trying to convert a 'tranny'.

So, if the skills to improvise a transmitter are gone, maybe there's no longer any need for the skills to communicate through it with Morse. But, skills or no skill, there's still a strong body of opinion among amateurs that "I had to study that damn Morse to get MY license, and so should HE!" This is not a technical requirement, more a taste of sour grapes. But it's a strong voice, and one that may be the deciding factor in the future.

So there's another subject for debate. But PLEASE, I do not intend to enter into any personal correspondence about it. There are enough nasties about the subject floating around on the amateur packet radio networks. Have a look there! ❖

OPTUS OFFERS NATIONAL SATELLITE COVERAGE

This month, Australia's mobile telephone options expand yet again, as Optus Communications launches its Mobilesat service. Based on the L band (1500MHz) transponders fitted to the B1 satellite and its new companion to be placed in orbit shortly, Mobilesat will provide a full service from anywhere in Australia.

by BARRIE SMITH

Earlier this year, we saw Australia's first *millionth* cellular phone customer 'go to air'. Analog cellular is due to be phased out in a few years, to be replaced by digital technology, which promises a superior service. But this month (September) will see the latest, and possibly most exciting phase in mobile telephony to arrive on the scene, rolled out by Optus.

Mobilesat is described as one of the company's mobile 'products', with an analog cellular service already well established and its digital GSM moving into user's hands and car interiors rapidly. While the current services cover major population areas, Mobilesat is intended to fill in all the rest, blanketing the entire Australian continent and extending out to sea by 200km.

Originally the service was expected to begin in late 1993, but changing technology has seen Mobilesat delayed as a viable product and service until now.

Directing the project is Dr Michael Wagg, Mobilesat Product Manager, who has overseen not only the establishment of the service, but has concerned himself with all the nitty gritty of developing the special handsets and transceiver units required.

A world first

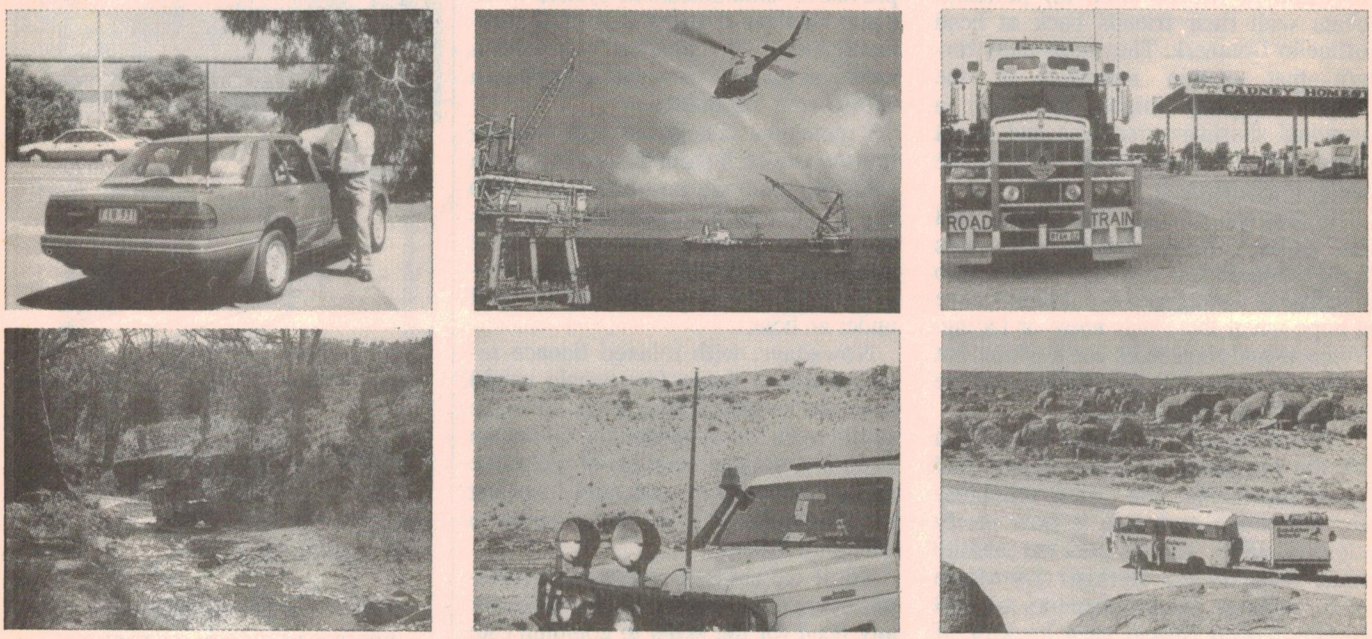
Mobilesat is a world first. From any part of the country you will be able to call any person in any part of the country or the world; the service will allow transmission of fax or data from a PC or telemetry to be sent and received; a GPS (Global Positioning Service) receiver can also be incorporated and used as a position identifier — this could be merged into an integrated communications system, permitting in-vehicle monitoring. Optus intends to introduce a VoiceMail service for call diversion, while an aviation phone version is also currently being investigated. In order to call anyone, you simply pick up the handset and dial. The call is transmitted on L band to (currently) the Optus B1 satellite, relayed back to the earth station, then switched through the normal telephone network.

As an Australian-designed and developed service, it means we will be the first country in the world to use a mobile telephone service operated by satellite.

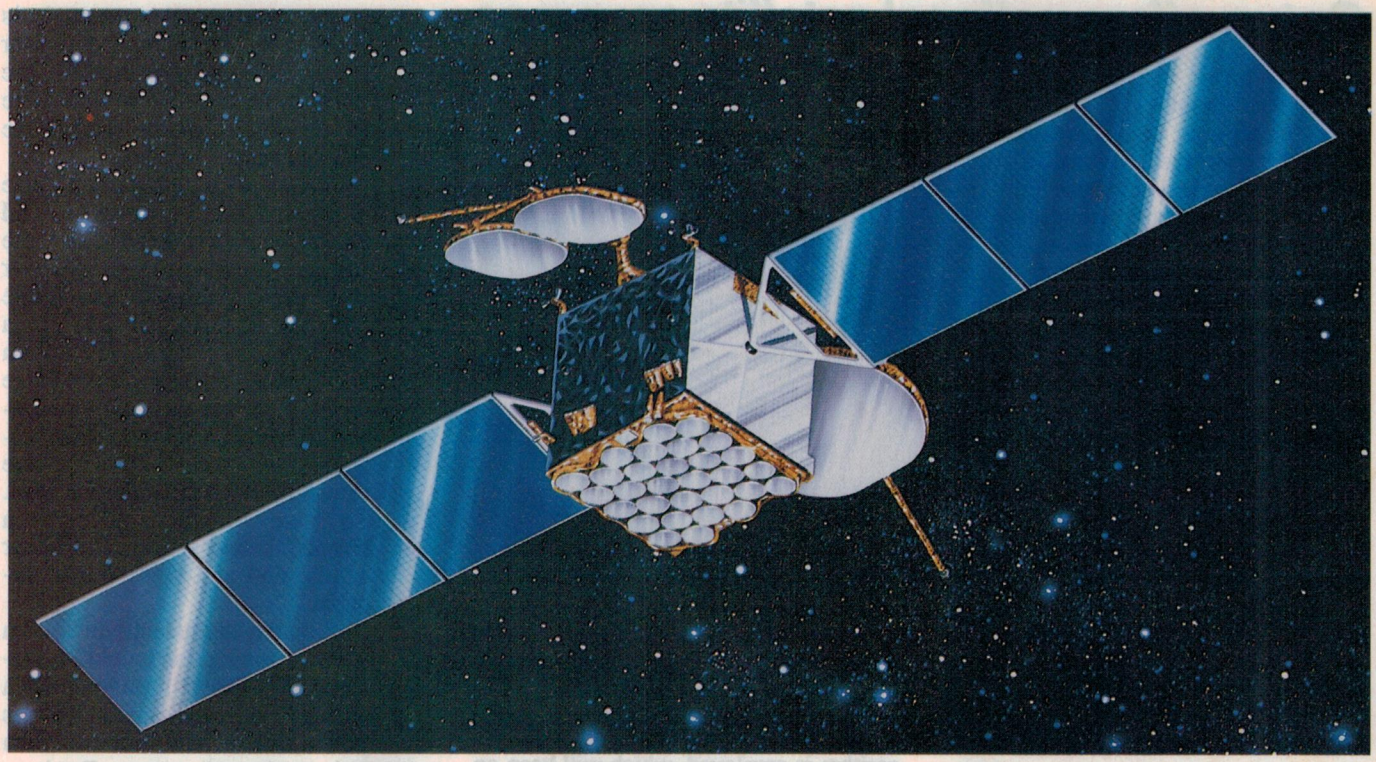
Optus expect the majority of installations to be in-car, with the handset mounted vertically or horizontally. The antenna is a rod one metre in length by 18mm in diameter, set preferably on the vehicle's boot or bullbar. Dr Wagg feels that roof mounting "is not an option for a number of vehicles — one low bridge could see the antenna not remaining a metre long for much longer!"

The transceiver has bulk similar to half a standard briefcase, and weighs around 8kg. It is expected this would be mounted inside the boot.

Using digital signal transmission and



For the first time, a complete Australia-wide phone/fax/data communication service will be available for mobile and fixed users, via the new Optus Mobilesat.



The Optus high power B1 satellite, built by Hughes. It will shortly be joined by an almost identical unit, to replace the B2 unit lost during launching. The 30 small dishes on the body of the satellite are connected to the L band transponder, used for Mobilesat. The larger dishes at the side are for K band, while the 'wings' are the solar panels.

reception, an operator could depend on a clear voice quality, with little interference or signal fade. It is important, however, that the antenna be aligned to have a clear line of sight to the satellite. To help the process the handset has a meter readout, giving a signal strength indication.

As Dr Wagg explains: "To put it in perspective, the satellite is something like 40,000km away; the antenna outputs a 3W signal on L band to the satellite, and accepts the return of the signal."

Wagg continues: "In terms of the equipment and service itself, we have two suppliers for the mobile telephones. The first of those is NEC."

The equipment

Optus created the Mobilesat specifications and designed all the transmission characteristics. The specification — a few hundred pages of detail — were given, in the first instance, to NEC to build the early examples. There is also a second supplier (Westinghouse), but their units will not appear until later in the year.

Explains Dr Wagg: "Westinghouse's concept is a little different. They'll have two boxes: there is one they call the antenna unit, which is basically an RF box, and then there's the transceiver unit, which is basically a baseband electronics box, which can fit within the vehicle."

"The difference is in the design philosophy. From the same specs they took a different approach. However, both will use the same antenna; both units draw a similar amount of power and the overall volumes are pretty much the same."

Although Optus would have preferred it, the hardware is not being built in this country. The NEC units will be manufactured in Japan, while Westinghouse will source from the USA. In NEC's case all the software is being written in Australia, at their Mulgrave (Vic) centre.

Wagg continues: "It's a fairly complex technology. We could have used off the shelf components, but it would have been more costly, called for more components, and offered reduced efficiency."

"We found with both the NEC and Westinghouse there's quite a lot of integration, so that a lot of the functions have been handled by customised chips. But you need to reach specific volumes to be able to achieve that."

A major factor is that Westinghouse plan to release identical product into the North American market in a year's time, when a similar service is introduced.

Dr Wagg explained that the US market is around 15 - 20 times the size of ours, so the project enjoys a little 'leverage' in terms of potential volume: "We're looking at a mature market in about five or six years of about 50,000 users, whereas North America is looking at something in the order of a million. For the investment to build a mobile telephone of this type you need, just to develop it, five or ten million dollars to design, develop, get it up and running — before you even begin to make one. If there had only been the Australian market we would have not the seen the price levels that we can offer.

And the price? The initial listed price of the handset/transceiver/antenna will be $7950 (ex tax). This is expected to fall below $5000 within a couple of years.

The user base of the service is expected to be mainly business users, especially those operating in remote areas, with the most obvious being mining and exploration groups. According to Dr Wagg the list could also include "police and emergency services, long distance transport companies, government services, defence, customs, even social security people."

One limiting factor of the send/ receive configuration is that a high speed modem cannot be used. The carrier rate uses a highly compressed voice signal, which sends at only 6.6 kilobits/second, while the fax and data will run at 2400b/s.

Dr Wagg explains: "In terms of the technology, the voice coding is very sophisticated. It is a digitised voice service and is three times as efficient as the GSM digital system. The reason we go for the efficiency is that when you transmit from a satellite, you're trying to squeeze as much out of the service as you

Optus offers national satellite coverage

can and you're working at the edge of the technology."

Bandwidth must be compressed and power conserved. A voice signal down a standard telephone line runs at around 64kb/s, while the GSM service in total uses about 20kb/s. Because Mobilesat transmission uses only just over 6kb/s, highly sophisticated processors are needed inside the mobile terminal equipment. "More computing power", Dr Wagg adds, "than, say, a standard home computer."

Why L band?

The L band used for Mobilesat is in the upper UHF/low microwave region of the spectrum, with frequencies just above 1500MHz. To put that in context, the current cellular telephones operate at about 800 - 900MHz, so L-band frequencies are about double those of the current cellular telephones.

According to Dr Wagg, "We're using L band because international treaties and ratifications have identified that as the spectrum for mobile satellite services. Its particular characteristics are that, for this type of service, you need line of sight to the satellite. So if you are behind a building, in a garage or something like that, you won't get a service. While it operates at two-to-three times the frequency, L band has similarities to UHF, but is more 'severe' in its characteristics."

Digital 'latitude'

In design, the service has some latitude: should a car be driving along a road lined with tall trees causing intermittent gaps, the digital processing enables the service to continue.

Explains Dr Wagg: "In terms of standard voice speech, the way it works is if you lose what we call a 'voice frame' it will fill in and smooth out between the two. So if you just lose a short period of speech you won't notice it. If you lose a long period it tends to blank it out. In standard communication there tends not to be a problem."

The signal processing takes a 'guesstimate' at what the missing material is. If only a short amount is lost, it taps the nearest previous voice data, predicts the likely successive data then interpolates this into the data stream. If too much is lost the gap is flagged and a dead break inserted. In transmitting fax and data, a complete error correction algorithm is employed, which will keep on repeating until the correct data is relayed; if there is a blockage, cancelling the signal, the processor will buffer the data until it can be sent clearly.

Unlike K band (as used for satellite TV), which suffers from 'rain fade', L band is not prone to such climatic effects and has characteristics similar to UHF. From an international perspective the main benefit is that the frequencies are globally common. Another advantage is that high performance can be extracted from relatively small antennae. One disadvantage is that the higher performance demanded from the waveband, the greater the accuracy required in terms of antenna direction.

Australian designed and developed, the Westinghouse handset and transceiver will be introduced in 1994. This unit will also be sold in the North America market, a factor which handed important benefits onto the Australian pricing.

As an overall system it is limited by the amount of power per voice channel available in the satellite. At the receive end there are limitations also in terms of the antenna gain.

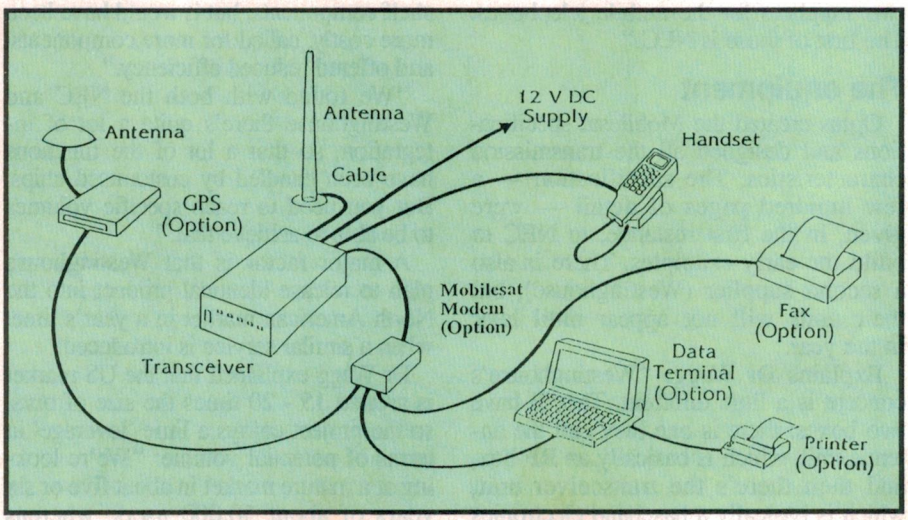
Dr Wagg makes this clear: "The bigger and more complex — and naturally more expensive — the antenna becomes the less power you need, while at the same time the antenna will take up a larger physical area. So when we looked at putting the service together, it was basically a compromise between cost of the antenna and that of the satellite resource, which is a recurring cost. So we needed to get a balance between what is cheaper at one end and what was affordable."

In tuning the antenna there is a level of tuning for height adjustment. The road antenna has a uniform pattern in azimuth, so as you move in the car and turn around it's got the same pattern. But it requires a slight adjustment in elevation.

The B1 satellite itself sits just over the Equator, to the east of Papua New Guinea. From Sydney the satellite elevation is about 50°. In Cairns it's about 65°. Go to Perth, and it's about 30°.

The antenna has an inbuilt margin of error of around 10 - 15° from vertical, so it can be tuned at the location for maximum performance. If you were travelling across Australia you would need to adjust it no more than two or three times. The pickup pattern is circular and horizontal, so the pattern could be regarded as an 'invisible dish'.

Continued on page 23



Configuration of a typical Mobilesat terminal in-car, with optional fax, data terminal and GPS facilities shown.

HEWLETT-PACKARD'S HP95LX PALMTOP: A TECHNICAL TOOL

A computer enthusiast from way back, Tom Moffat tried out one of H-P's tiny new HP95LX palmtop computers and immediately 'had to have one'. As he explains in this review, it's not just because it contains a host of features for engineering calculations — but also because it effectively includes a complete inbuilt MS-DOS computer...

by TOM MOFFAT

How many of you have met up with Hewlett-Packard's HP95LX? I would say lots of *EA* readers have probably seen one, without realising what it is. The 95LX looks like one of those 'personal organisers' that have become so popular among business people. But deep down inside the thing is a full-blown MS-DOS computer, that fits in the palm of your hand.

Mainstream computer magazines have tended to dismiss the HP95LX as a yuppie toy, and on the surface that's just what it looks like. The 'personal organiser' part of it has an address book, and an appointment diary, and a notepad. These things are 'sorta' useful, but most non-yuppies get along quite happily with a little spiral-bound book and a sharp pencil.

When you fire up the 95LX you enter a program called the 'system manager' which takes control of all operations. It announces its presence with an opening screen which looks like a business card containing your name and address. You can also decorate the screen with a graphic or your company logo. I set mine up to display a photo of myself, the same one that adorns Moffat's Madhouse. I did this before taking the computer overseas, so if there was a dispute over ownership or origin of the computer, I could just say 'let's boot it up and see whose picture is there'.

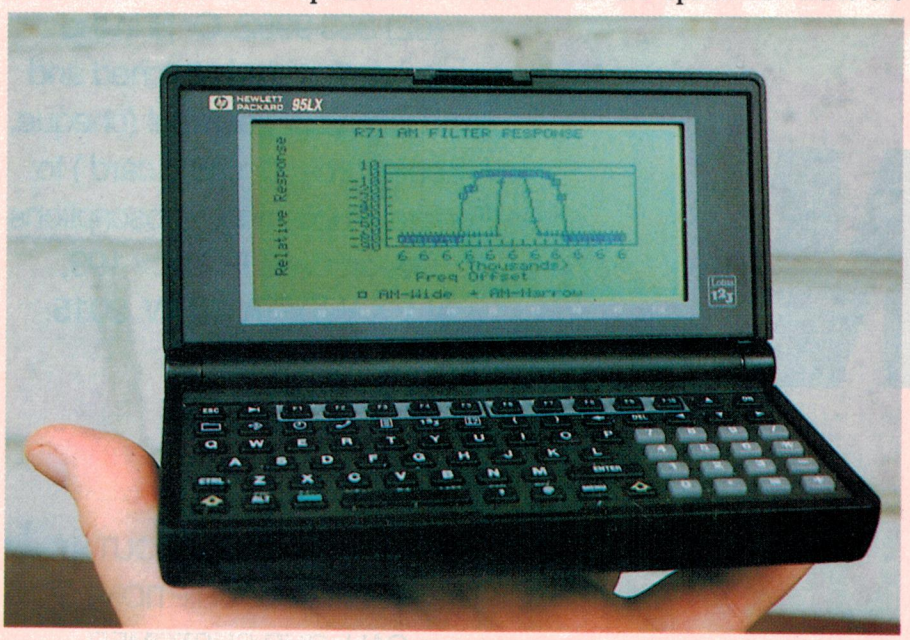
With the press of a button you can call up the personal organiser functions, or more useful things such as a file-handling program, a communications package, a real rip-snorter of a calculator, or a fully functional version of the Lotus 1-2-3 spreadsheet program.

The entire keyboard is made up of little buttons instead of keys, and the screen handles 16 lines of 40 characters. But a software option can make the screen look like a 'window' into a full 80 x 24 IBM screen which shifts around as you type.

All of the factory-supplied applications are contained in heaps of ROM (read only memory). Lotus 1-2-3 is by far the biggest program, and I decided since it was there, I might as well use it. I've always kept my business records in a spreadsheet program called SuperCalc, and it wasn't hard to convert the data files into ones Lotus could understand.

Now I have a full stock inventory in the palm of my hand, with separate data files for Listening Post II, WESAT, and Pocket Packet kits. Before I do a run of 50 or 100 kits, the HP95LX tells me how many of each part to order and what they are going to cost. I always keep a few smaller parts as extras, and when the run of kits is completed I do a stocktake. The computer knows how many parts I should have left over, and if my count disagrees I know one or more of the kits has an incorrect parts count. Then I get to count the kit parts all over again(!), but at least the computer ensures that it's very unlikely a kit will go out the door with parts missing.

Spreadsheets are also very useful for engineering calculations (See *EA*, November 1989), and Lotus 1-2-3 in the 95LX does the job nicely. Graphs are even possible on its tiny screen. The photo shows Lotus displaying a frequency response graph of the wide and narrow AM filters in an Icom R71 communications receiver. The data were manually measured with a signal generator and then entered into the spreadsheet, which automatically drew the graph.



Tom's 95LX is shown here displaying a frequency response graph of the wide and narrow AM filters in an Icom R71 communications receiver. The data were manually measured and then entered into Lotus 1-2-3, which drew the graph.

Calculator options

Now to that in-built calculator. Although referred to in the HP documentation as a 'financial' calculator, the calculator program seems to embody everything an engineer has ever dreamed

of in an HP calculator. For a start there's that good old Reverse Polish Notation that seems weird when you first encounter it, but so logical later on. You can optionally revert to normal algebraic style if you prefer.

The financial calculator does Time-Value-Money calculations to work out the value of a loan as influenced by interest rates and length of the loan. Technical people might not find this too useful, although you could do a run on your own home loan and possibly beat the bank at its own game by refinancing at a rate more favourable to you instead of the bank. There is also an extensive conversion facility, so you can work out that one chain equals four rods equals eleven fathoms.

If you're doing business overseas the currency conversion feature is handy, and you can plug in the new rates as the Aussie dollar makes its daily nosedive. This is essential when you are on a trip to the USA where everything seems so cheap. Expressing the prices in our money is a sobering experience.

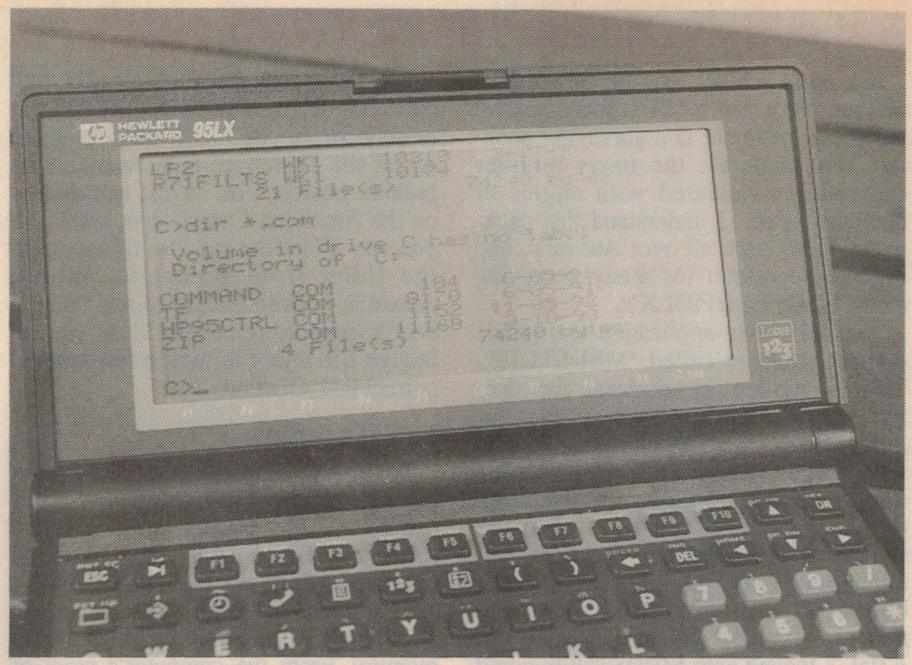
Selecting the MATH choice from the calculator menu opens the door to a rather snazzy scientific calculator. Here live all the things you need for electronic and other technical work — such as square root, log, sin, degrees, radians, etc. There are 10 storage registers, and results can be displayed up to 15 places. I was amazed at the calculator's accuracy; I took the square root of two, and then squared the result, and then took the square root again, and squared it again, several times. And I could never make '2' show anything other than 2.00000000000000. Usually a calculator will 'drift' away from the correct answer when doing this.

The solver

Of particular interest to electronics people is the solver. Here you can enter a formula, such as Rt=R1*R2/(R1+R2) to work out the value of two resistors in parallel. The normal way is to feed R1 and R2 into the formula, which then gives Rt, the total resistance.

But if you want to know what resistor to put in parallel with 10k to produce 5.5k, you can give R1 and Rt to the solver and tell it to produce R2. This it does, apparently by some form of iteration. Numbers flip all over the place on the screen, and eventually they stop, showing 12.22k for R2. A very useful gadget, this solver.

When one of the applications is running in the 95LX, you can call up another on top of it. And another on top of that; stacking applications several deep. It's almost like multi-tasking, but not quite — each application is carefully suspended, with all data and microprocessor registers saved, before the new application is allowed to start. When you exit the new application, the System Manager restores the previous one exactly as it was when you left it.



This close up view was taken by Tom to show how the 95LX can produce a file directory listing just like any MS-DOS computer.

The system manager also saves everything when the computer is turned off, so it is exactly as you left it when you turn it back on again. And 'off' isn't really off; it's more a state of suspended animation that HP calls 'deep sleep', where battery drain is reduced to a trickle.

There is also a 'light sleep' that comes into effect automatically, usually when the computer is sitting there waiting for you to press a key, which is most of the time. When you touch a key the machine springs back into action, and you'd never know it had been loafing...

That's all that many users will ever see of the 95LX, the applications brought up by pressing the blue-labelled buttons. And for the busy executive it's probably all that's needed. Many never realise that beneath all the gloss of a personal information manager lurks a complete MS-DOS computer, probably the world's most portable — with the most blow-up-proof input/output system possible, in the form of an infrared link. This makes it ideal for experiments in the lab, in the field, and in the workshop.

Despite the refusal of 'power users' to take the HP95LX seriously, people of a more technical bent are lapping it up like a cat with sweet cream. The HP95LX is even developing a cult following, just like some of the stars from the earliest days of computing. Old timers (like 10 years back) will remember the Motorola 6800 and 6809 Development kits, and the SWTPC, and CP/M and its S100 bus. In Australia there was the Microbee cult. Now it's all happening again, with HP95LX ideas and information flowing around the world's computer bulletin board networks.

The home base of this cult is the Hewlett-Packard facility at Corvallis, Oregon, in the USA. The guru presiding over it is a fellow named Everett Kaser. It appears that the HP95LX is his baby, and from time to time he holds court on the bulletin board networks as the faithful fall to their knees in his presence. He even gives out his home phone number for private consultations.

Part of the attraction of the HP95LX, I suppose, is the name. Any engineer or technician worth his salt would 'kill' to own something with Hewlett-Packard written on it. It is like having a car with 'RR' stamped on the front. In fact, the original name given to the HP95LX project was Jaguar; I guess Rolls-Royce would have been a bit much.

Many applications

Experimental work taking place on the HP95LX is generally referred to as 'hacking' in the nicest sense of the word, meaning making the computer do things it was never designed for. The 95LX now talks, barks like a dog, and crows like a rooster. It remote-controls video recorders with its IR link, dials telephones and paints pictures.

In a more serious vein, the HP95LX is making its presence felt in lots of useful ways. An example is a surveying package that does all the nasty number crunching associated with angles of declination, etc. I understand this package is being used all over Australia, and is the sole reason for many surveying students buying HP95LX's.

Another clever application is a public domain package called 'MEDSTUFF'. This is written by doctors, for doctors. It has a spreadsheet file for Lotus 1-2-3 that acts as a database to warn what interactions are possible when two or more drugs are given to a patient at the same time. Another feature calculates the required administration rate for intravenous drips, based on the substance being administered and the patient's body weight. A 95LX loaded with MEDSTUFF would be a very handy gadget indeed for a busy hospital physician.

I keep hearing noises from the USA about a plug-in card being developed that will allow the HP95LX to interface to a cellular telephone as a portable data terminal. So when a salesman says 'let me check with the main computer' he can do it standing in the middle of the street if necessary.

My own project

My own first major development effort on the 95LX has been a version of the Listening Post II weatherfax decoder. The actual 'decoder' gadget doesn't connect to the computer at all; instead it shoots decoded picture data at it over an infrared link. The result is tiny but useful weather charts on the screen, with all the positive/negative and upside-downing and screen scrolling features of the original Listening Post II.

The computer of course is battery powered, and the decoder/infrared transmitter draws only 6mA from a 9V transistor battery. Combined with a radio such as the Sony ICF-SW7600 pocket communications receiver, we have what I hope is the world's first hand-held weatherfax system.

As this is being written I'm trying to decide whether to describe the decoder as a kit in *Electronics Australia*, or to automate the software further and produce a fully-built commercial product for the marine and aviation markets. It's small enough now that it can even be taken on bushwalking journeys, where a regular supply of fresh weather maps would be of immense value in planning each day's activities.

It appears that there are already well over 500 software packages written expressly for the HP95LX. Most of these are of the Shareware type, available on bulletin boards. The largest selection is on the American Compuserve system, if you can afford the expense of accessing the thing from Australia. Within Australia I haven't heard of any bulletin boards supporting the 95LX as yet, although I'm trying to twist a few arms to correct that situation.

PCMCIA slot

To do any but the most basic experimental work on the 95LX, it is necessary to expand the machine somewhat. This is done via a slot in the left-hand side of the case, that takes the new PCMCIA memory cards. These can be either read-only, or read-write memory. From the computer's point of view, the memory card looks like another disk drive designated A:. The C: drive is the smallish RAM drive already in the computer itself.

The memory cards come in sizes from 512KB for a 'small' RAM card, up to two megabytes for ROM cards. So a ROM card can contain a whacking big application, even though it's for a tiny computer. When the 95LX is booted (the usual CTRL-ALT-DEL sequence), it first looks to see if a PCMCIA card is in the slot. If a card is installed, and if it has a DOS-style AUTOEXEC.BAT file on it, the computer will boot up to the A: drive and then execute whatever is in the AUTOEXEC file. Thus any application on a plug-in card can take complete control of the 95LX, dispensing with the system manager and all the applications it controls.

For my own development work I use a 1MB RAM card with an AUTOEXEC.BAT file that brings up MS-DOS, does a DIR, and then sits on the A prompt waiting for commands. This 'disk' is divided up into directories for various programming languages and for word processing. It also has a copy of the VDE editor which I use for all my writing in the 95LX and on bigger computers. The VDE program was designed to recognise when it's running in an HP95LX and configure itself accordingly.

I have written small experimental programs on the 95LX in BASIC, Turbo Pascal, C, and assembler. There are no problems at all and system calls work as expected, except for graphics functions which are special for the 95LX.

The HP95LX can run the usual .COM or .EXE programs under MS-DOS, and the majority of programs you'll write will be of this type. But it is possible to write programs just like the snazzy inbuilt HP95 functions that can be used alongside Lotus, the address book, and all the rest. These programs must follow a very tight structure to allow them to coexist with other applications. Such programs are said to be 'system manager compliant' and are characterized by the filetype .EXM

In the normal course of events, with the 95LX running under the system manager, you can start any .EXM file by pressing a key which you have specified when installing the program. You can call up any .EXM program while running any other and they keep stacking on top of each other, just like the inbuilt applications.

An example of a user-written system management compliant program is the excellent CMCALC programmers' calculator, distributed world-wide as Shareware. It can be started by pressing the ALT key plus the regular calculator start button. CMCALC has been carefully engineered to provide the same 'look and feel' as the built-in HP calculator. But it works only with integers, and it knows about hexadecimal, octal, and binary notation. CMCALC lets you shift and rotate registers, add, subtract, multiply, or divide them, AND, OR, and XOR them. You can thus try out weird programming ideas, step by step, before actually encoding them into a program. I use CMCALC all the time while working out new and unusual ways to crash a computer!

The guts of the HP95LX is a single LSI chip known as the 'Hopper'. The origin of the name is unclear, but I suspect the chip may have begun life as the 'HP-er'. Say that fast and you've got Hopper. The Hopper contains all the functions of individual IC's used in a more conventional PC, such as the serial chip, the interrupt controller, the DMA controller, and the video controller.

The 95LX microprocessor is an enhanced 8088 processor known as as a V20, running at a clock speed of around 2.5MHz. This will bring sniggers from power users with their 486-based computers — even more so when I point out that the 95LX will run CP/M, a dinosaur operating system that was used before the IBM-PC came along in 1982. The V20, introduced by the NEC company, was an 8088 with a few souped-up machine instructions, combined with an 8080 microprocessor from the early 1970's.

As far as I know CP/M and the 8080

have never been mentioned in any HP95LX documentation, but if the thing emulated a V20 all the way, the 8080 had to be there as well. And when I tried it, sure enough, two CP/M interface programs for the V20, namely 22NICE and V2080, ran fine. Through them I was able to run such gems as a 1975 version of Microsoft BASIC.

The only problem came when exiting CP/M mode; the 95LX locked up and has to be re-booted. But when I get some time I'm going to investigate that problem and hopefully find a way to put a stop to it. I guess I'll always be an incurable CP/M hacker!

Three in one

What we really have here, then, are two different computers in the same box. Or three, if we take CP/M into account. If we let the system manager take control, we have a fancy task-switching personal information manager-cum-Lotus 123 financial computer thingo. But if we short-circuit the system manager, we have a very traditional MS-DOS computer with a funny little screen and a funny little keyboard.

I remember when personal computers first came along; there used to be magazines like *Kilobaud Microcomputing*, *Dr Dobbs Journal*, and *BYTE*. They used to run these great articles on how to add a proper keyboard to your 6800 developers kit or how to control your lawn sprinklers with your CP/M machine. Now the earliest computer magazines have gone and those remaining, such as *BYTE*, concentrate on articles and reviews about the very latest 'power' computers which few people have any use for and fewer still can afford. Boring! I gave up my subscription about the time *BYTE* gave up publishing program listings.

But now we see experimental work resurrected. Not in the magazines (yet), but on computer bulletin boards. Messages like 'How can I turn my HP95LX into a garage door opener?'. Now there's an idea, it could probably be done fairly easily with the 95LX's infrared transmitter. Anybody want to give it a try?

After this introductory article on the HP95LX I intend to sit back and see what interest it generates. If there is enough, I'll write some more, about things like taking over control of the 95LX's infrared, and perhaps doing funny things with its sound output (an 8-bit D/A converter).

So, dear hardware hackers out there, I've kicked the door open. Shall we step back through, to the time when computers were fun? ❖

Optus offers national satellite coverage

Continued from page 18

Other L band users

In terms of mobile satellite applications, the only other mobile satellite services using L band are international maritime applications, such as super tankers. These use a dish set, about one metre in diameter, on a gyroscopically stabilised platform, compensating for the ship's motion. The cost of these is $30 - 40,000. Transportable versions are also in use: probably the best known ones were those used by CNN in the Gulf War. Many US companies are currently offering briefcase versions.

Also operating in L band, but using a slightly lower frequency, are the GPS (Global Positioning System) units — currently sold here under Sony, Panasonic and Icom brand names.

Slightly higher in the L band are operators using standard microwave point-to-point services. While across the whole waveband there is a pretty eclectic mix of uses, Optus Mobilesat occupies only two fairly narrow sectors of 14MHz.

Handheld future?

In Dr Wagg's view the Mobilesat service has great potential, "but to take it to a handheld portable stage, clearly we're about one technology step away from doing that at the moment. You could do it — but the cost would be far too high, especially for the cost of the transceiver with its high level of processing power."

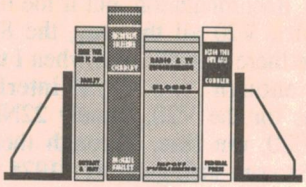
Adds Dr Wagg: "We know that the military are going to be using our system, but in terms of specific frequency bands they tend not to use L band. There is a band called X band, which is above C band and below K band, dedicated to military use."

"It's not that the frequency is insecure, it's more a case that other frequencies have been allocated to them by a worldwide process."

As Dr Wagg sees it, a cellular service is basically restricted by its VHF or UHF carrier, demanding line of sight operation and a degree of proximity. Cellular systems predominate in urban areas and major highways.

Move away from these areas and until now you basically haven't got a service. But with the B series satellites always in sight, wherever you are in Australia there is now really 'nowhere for the signal to hide'! ❖

NEW BOOKS



Oz innovations

TOMORROW'S WORLD: The Australian Initiative. Published by Michael Soker, Associated Publishing Corporation, 1993. Soft covers, 305 x 210mm, 224 pages. ISBN 0-646-16294-2. RRP $39.95.

We Australians are often inclined to play down our achievements, and adopt a kind of 'not invented here' philosophy. Probably the boomerang, the stump-jump plough, the pedal wireless and the rotary clothesline are about the only inventions that many Australians would be able to bring to mind as things invented here. Yet there are a vast number of inventions and innovations that Australians have produced, many of them very significant indeed: like the atomic absorption spectrophotometer, the ultrasonic scanner, the bionic ear, the 'black box' flight recorder, the electric drill, the Split-Cycle IC engine and the Vapocure paint drying process, to name only a few.

That's the idea of this book — to raise the general awareness of Australian contributions to science, engineering, medicine and business. It's essentially an encyclopedia of Australian 'world first' innovations — over 300 of them, many still available on the market.

A very nicely produced book, it has concise text descriptions and plenty of crisp four-colour illustrations, well printed on good gloss stock. There's even a foreword by PM Paul Keating, endorsing the book's aims and commending the products and services it describes.

As well as providing a cheering and encouraging read, it's a book that would make an excellent resource for student essays and projects. It would make an excellent gift for overseas friends, too.

The review copy came from McGraw-Hill Australia, which is distributing it for APC. I imagine copies are now available in all major bookstores. (J.R.)

MIDI in more depth

ADVANCED MIDI USER'S GUIDE, by R.A. Penfold. Published by PC Publishing, 1991. Soft covers, 217 x 138mm, 179 pages. ISBN 1-870775-18-X. RRP $29.95.

Another book on the MIDI (musical instrument digital interface) system, this time for those who would like to go beyond the stage of merely using it to hook up various keyboards, instruments and a sequencer or computer. As the title suggests, it goes into the 'nitty gritty' of things like MIDI operating modes, message codes (including system exclusive messages), routing, problems and their solution, synchronisation and programming.

There's quite a lot of in-depth information on MIDI, especially from the hardware side. The author even discusses the use of a PC for MIDI analysis and troubleshooting, and gives some circuits for a simple MIDI switch box and typical MIDI input, thru and output stages. One of the appendices at the rear also gives what looks to be a full and detailed listing of MIDI Specification 1.0.

I was a little surprised, though, to find no real discussion of things like General MIDI, MIDI interface cards for PCs or PC-based MIDI software. This seems a significant omission in a book intended for the 'serious' MIDI user, considering how many MIDI systems now use a PC as the main sequencer and control centre — and how much terrific MIDI software is now available.

Still, this is not a big and expensive book, so I'm perhaps expecting too much. What it does cover is fine, and still makes the book good value for money.

The review copy came from Australian distributor Astam Books, of 57-61 John Street, Leichhardt 2040. However I understand it will be available shortly via the Federal mail-order bookstore. (J.R.)

Repairing CDPs

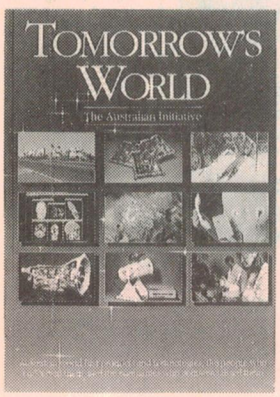
TROUBLESHOOTING & REPAIRING COMPACT DISC PLAYERS, by Homer L. Davidson. Second edition, published by Tab Books/McGraw-Hill, 1994. Hard or soft covers, 243 x 192mm, 488 pages. ISBN 0-07-015669-7 (hard cover), 0-07-015670-0 (soft cover). RRP $89.95 h/c, $49.95 s/c.

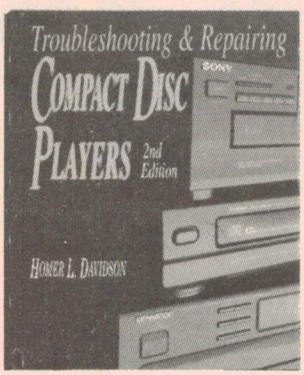
The first edition of this book became very popular with service technicians, I understand. Now the author has given it an extensive expansion and updating, so the new edition should be even more valuable. Homer Davidson is both an experienced service technician and technical author, having written eight other popular servicing books.

Each chapter has been revised and expanded, and there's a great deal of solid practical information on CD player faults, diagnosis, adjustments and repairs. There's also a section at the rear giving full circuit schematics for nine different models. Although US models are discussed, this shouldn't prove much of a problem here since virtually all of them are made in Asia and similar models would have been sold in Australia.

There are lots of explanatory diagrams and pictures, plenty of hints on effective servicing techniques and even information on making your own simple servicing aids such as an IR sensing unit for checking both laser pickups and remote controls. In short, it should be a particularly valuable reference book for anyone involved in servicing CD players.

The review copy came from distributor McGraw-Hill Australia, of 4 Barcoo Street, Roseville 2069; phone (02) 417 4288. (J.R.) ❖





Australian researchers playing a key role in creating...

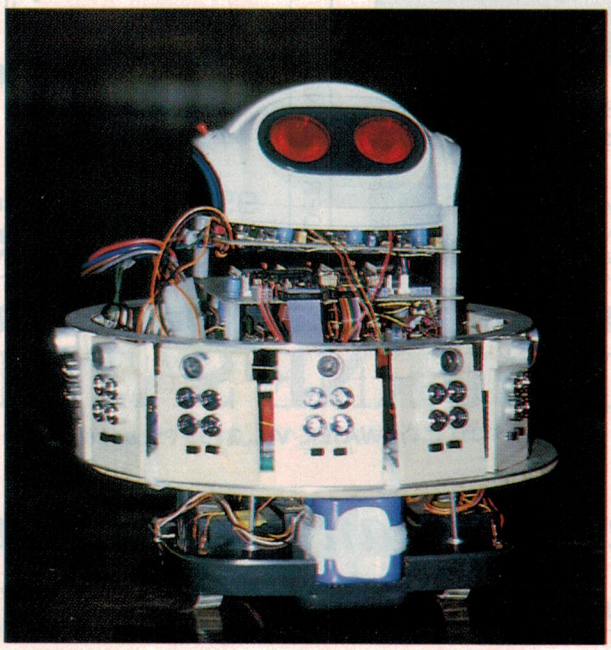
TOMORROW'S ROBOT BIZARRE

In the last few years, researchers around the world have been developing a new generation of robots — machines which are a far cry from the relatively crude models currently used for spot welding and other dirty repetitive work in assembly lines, etc. The new robots are fast acquiring vision, intelligence, mobility and dexterity — and Australia's researchers are playing a major role in their development.

by PAUL HENDY

Oils ain't oils, and robots ain't robots any more. Gone is the dirty industrial image; 'service' robots with brand new bionics and clean uniforms are coming to town.

Representatives of the new service breed include ScrubMate the toilet cleaner, and HelpMate the 'fetch and carry' hospital courier; the British robo-surgeon for brain tumours being used in two hospitals; the patient-handling robot, designed to save nurses' backs; the German 'Skywash' Jumbo Jet cleaner, with a 26- metre stretch; and a product-disassembly robot. There is also the gangly French MAGALI fruit-picker, MARTHA (the mobile cargo handling robot for wharf and rail cargo), and the Seattle water- jet cutting robot for processing fruit and vegetables and ceramics, the equal of any laser cutter — to name a few. Phew!



MEEGHAN, an autonomous robot 20cm high, developed by Prof Chris Drane and Dr John Leaney of the University of Technology, Sydney.

The creators, trainers and promoters of these robots are hoping that we can put aside our fears and prejudices, to accept them into our busy workplaces and into the rhetoric of innovation, competitiveness and new applications opportunities.

Acknowledged father of industrial robotics, American Joseph Engelberger of Transition Research Corporation, says that the new helpers and servers "will be doing all the tasks for us, while humans do the monitoring of robots".

Engelberger built the first, practical three-axis robot, called Unimate in 1961, begatting the automated car-welding industry. He hopes that his new ScrubMate cleaner and HelpMate courier will be working hard for white collar industries at $5 per hour rental fees — "half the cost of human labour", he says.

Should we all be ducking for cover, or perhaps preparing the vats of boiling oil?

Association view

According to various promoters of the 35-member strong Australian Robotics Association (ARA), the new service robots are bearing important new messages for Australia — about exciting new domestic and Asian markets.

Robots and robotics, they say, will enhance our strengths, which 'lie primarily in non-manufacturing, (especially) food processing, health care, retailing and tourism'. They also are preaching the gospel of better jobs (for humans), improved occupational health and reduced human risk, and more time for creativity and leisure.

Professor Hartmut Kaebernick, President of ARA and head of the School of Mechanical and Manufacturing Engineering, University of New South Wales, says that "some of our neighbours are accepting and applying new technologies (robots and computer-integrated manufacturing) at an alarming pace" — citing Indonesia and its robotic aircraft factories, and 'clever island' Singapore with its new automation policy that is set to boost its 1536-robot workforce.

Australia currently has a population of 1650 industrial robots (in welding and palletising), and an annual intake of 150 new robots a year.

"It depends mainly on our performance whether our neighbours become a technology threat or a market opportunity for Australia", he says.

ARA also has its eyes firmly focussed on recent Japanese Industrial Robot Association (JIRA) figures, showing that 99% of Japan's 275,000 robots are manufacturing robots and only 1% in service. That translates into golden opportunities for Australia's 100 robotics technologists, who are located in some nine universities and two CSIRO departments — as well as for 150

James Trevelyan's sheep shearing robot was created by a team of engineers and scientists at the University of Western Australia. The robot has advanced terrain following and motion control capabilities.

various 'implementers' at 23 organisations and businesses selling imported robots and value-adding to them.

Australian role

Australian research and development in the 'artificial helper' and robotics field is world class. Currently researchers hold significant technology lead times in respect of machine kinematics, bionic vision (retina chips) and artificial intelligence (the robot brain).

The Australian work represents a mechanical bio-diversity of numerous surprises, to match a natural diversity which includes such oddities as artificial creatures, climbing crab welders and microrobot engineering. Beginning with kinematics — the art of mobility — Australia has taken an early world lead with one of the fastest and most agile robots.

James Trevelyan's robot sheep shearer is one of the kinematic and mechanical successes in the most challenging areas of service robotics — a machine which adapts to the messy, disordered irregular world.

Created by a team of engineers and scientists at the University of Western Australia over 16 years, the robot has an advanced terrain-following capability and unique motion control techniques, which overseas researchers now hail as 'an example of just how clever robots can be' ('Robots for Shearing Sheep: Shear Magic', 1992, James Trevelyan).

Engelberger says that the robot has the fastest servo-drives in the West, and that the sheep handling mechanisms alone are powerful enough to begat a commercial revolution, besides the clever 'Edward Scissorhands'.

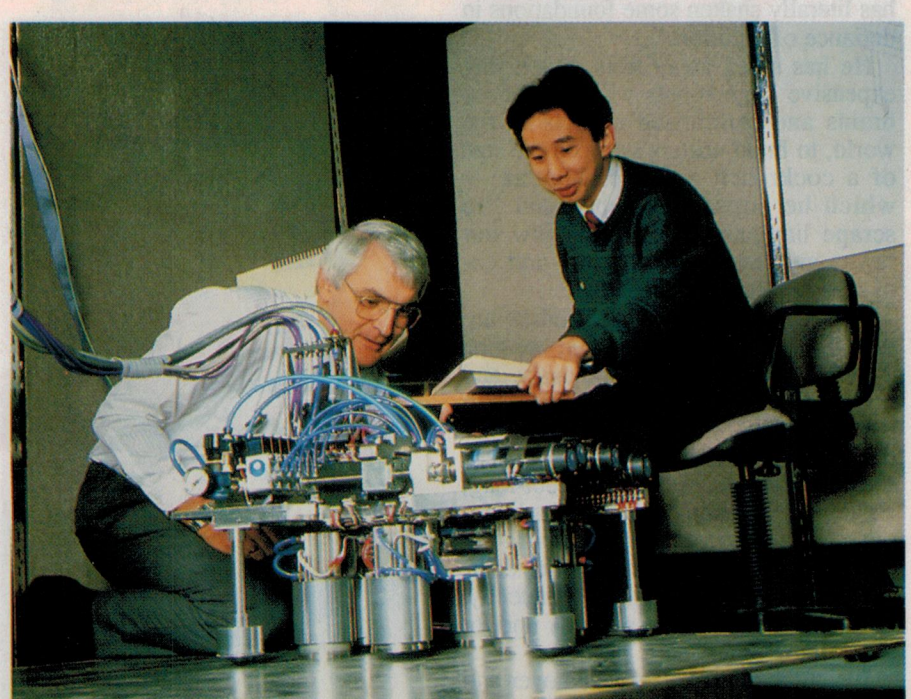
Developed to save the sheep farmer on the land from plummeting wool prices and $400 million annual shearing costs as well as saving some 'iron men of the outback (from) broken backs, arthritic joints, dermatitis and kidney disease', Trevelyan says that the techniques to develop this advanced robot have been around for "five to 10 years, and only required some listening and a little lateral thinking".

He also says his robot "serves only as an extension of human activity, not as a replacement".

The sheep shearer with its advanced kinematics could find applications in manufacturing, to paint or heat-treat irregular shaped surfaces or in packaging.

Trevelyan says he will continue to develop machines that provide simple solutions to human needs, and his next project idea is a soil-chemical monitoring robot.

Another ingeniously agile robot is PLOD, developed by Dr Kevin Rogers and colleagues of the Melbourne section of the CSIRO's Division of Manufacturing Technology. PLOD is a small wall-



PLOD, a wall climbing robot, was developed by Dr Kevin Rogers and colleagues of the Melbourne section of the CSIRO's Division of Manufacturing Technology. It is capable of numerous tasks, including welding.

climbing robot, which can be the vehicle for numerous tasks including ship welding or polishing of welds, painting and inspection of large steel structures.

Dr Bijan Shrrnzadeh of the Sydney section of the Division has three others robots in development, but he cannot release their details for industrial secrecy reasons.

The CSIRO is also currently trialing the FUTUTECH slaughter robot chain, at Kilcoy Abattoir in Queensland. FUTUTECH is not as agile or as fast as human workers or Trevelyan's shearer, but the robots "can process 300 cattle a shift and work 24 hours a day", according to Les Day, the Federal President of the Australasian Meat Industries Employees Union.

Artificial 'critters'

At the University of Technology in Sydney, equally exciting work is just emerging in artificial creatures. One of the most provocative ideas to come out of the robotics field in recent years has been Professor Rodney Brooks' 'subsumption architecture' and 'distributed intelligence' theories. An expatriate Australian from Flinders University in Adelaide and now at the Artificial Intelligence Robotics Laboratory of 'the classicist's Kingdom' — MIT — Brooks has literally shaken some foundations in defiance of tradition.

He has shied away from developing expensive large robots with centralised brains and centralised models of the world, to build critters between the size of a cockroach and a chihuahua — which he hopes might be used "to scrape barnacles off ships, mow our lawns and become inspectors and explorers in rough terrain".

After noting that insect bodies are dotted with widely distributed sensors, which work almost autonomously, and observing how they respond with reflexes to their environment, he decided to build the mechanical metaphor. His pioneering one-foot-long, six-legged 'Ghengis' of 1988 had sensor-studded legs and whiskers, infra-red eyes and 57 'behaviour' circuits dedicated to controlling legs independently, so as to avoid obstacles and stay upright at the same time.

When the small robot walks over and around obstacles, people describe it as 'eerily lifelike'. His more advanced Attila and Hannibal are subset visions of a critter world, which Brooks hopes will "become accepted in the fabric of life as small workers".

The HelpMate service courier robot was developed by American Joseph Engelberger, the acknowledged 'father of industrial robotics'. Prof Engelberger developed the first practical Unimate robot in 1961.

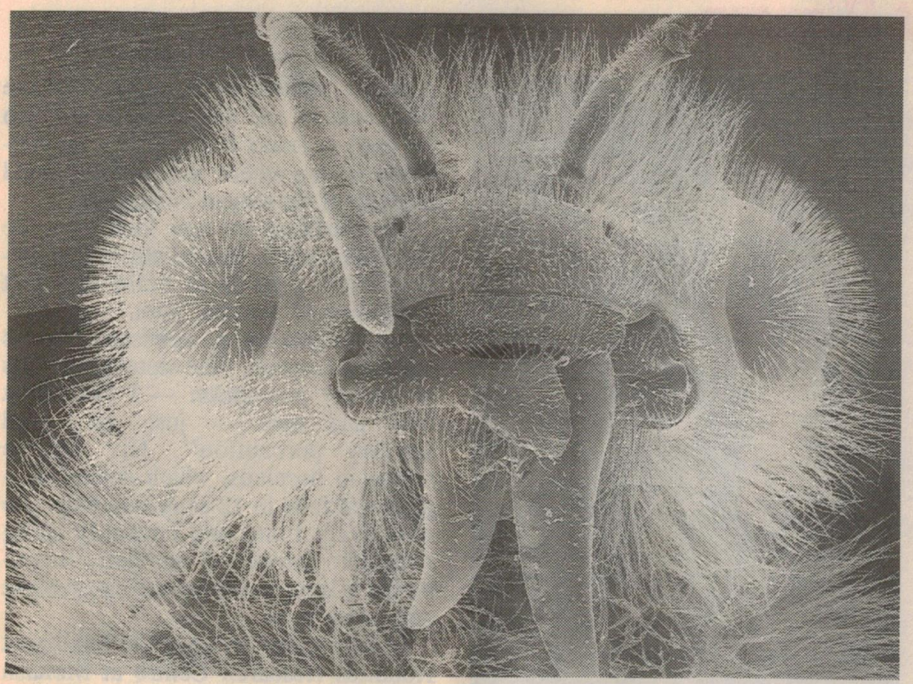
Professor Chris Drane and Dr John Leaney of the University of Technology, Sydney have used the Brooks approach to build the 'autonomous' 20cm high MEEGHAN, and 'ERIC-the-half-a-fish' which they hope to test in Darling Harbour shortly as the first Australian 'underwater insect worker'. They hope that these small robots can be used for undersea oil platform and pipeline inspection, or in hazardous areas, security patrol, or even as an office guide. "That's because it doesn't need an expensive, complex pattern-recognition brain — it just works out there is something there with its sensors, and it avoids it", says Drane. "It breaks the current expensive AI trend towards highly rational robots."

A HelpMate robot, modified for a different type of cargo. Many HelpMates are in use in US hospitals.

Leaney says that their robots are the first in Australia designed to "find out what the ultimate meaning is (of subsumption architecture), and what the ultimate applications are".

The UTS scientists are also building the Brooks architecture into a new 'responsive' sensor skin of an industrial robot arm, to improve work safety by sensing human proximity. "There have been deaths overseas", Leaney says, "although you can count those accidents (globally) on two hands."

And to show that size isn't everything, RMIT scientists have gone one step lower on the evolutionary scale into micro-robots, to begin to complete the bio-diverse picture. Micro-motors less than a millimetre in size are being developed by RMIT scientists Dr Ron Zmood and Professor Dinesh Sood, under a $150,000 Japanese MITI Government contract to develop micromachinery.



A close up view of a honey bee's eyes. ANU scientists, led by Prof Adrian Horridge, have created the first bionic eye — 60 integrated photodetectors on a chip — based on the principles of insect vision.

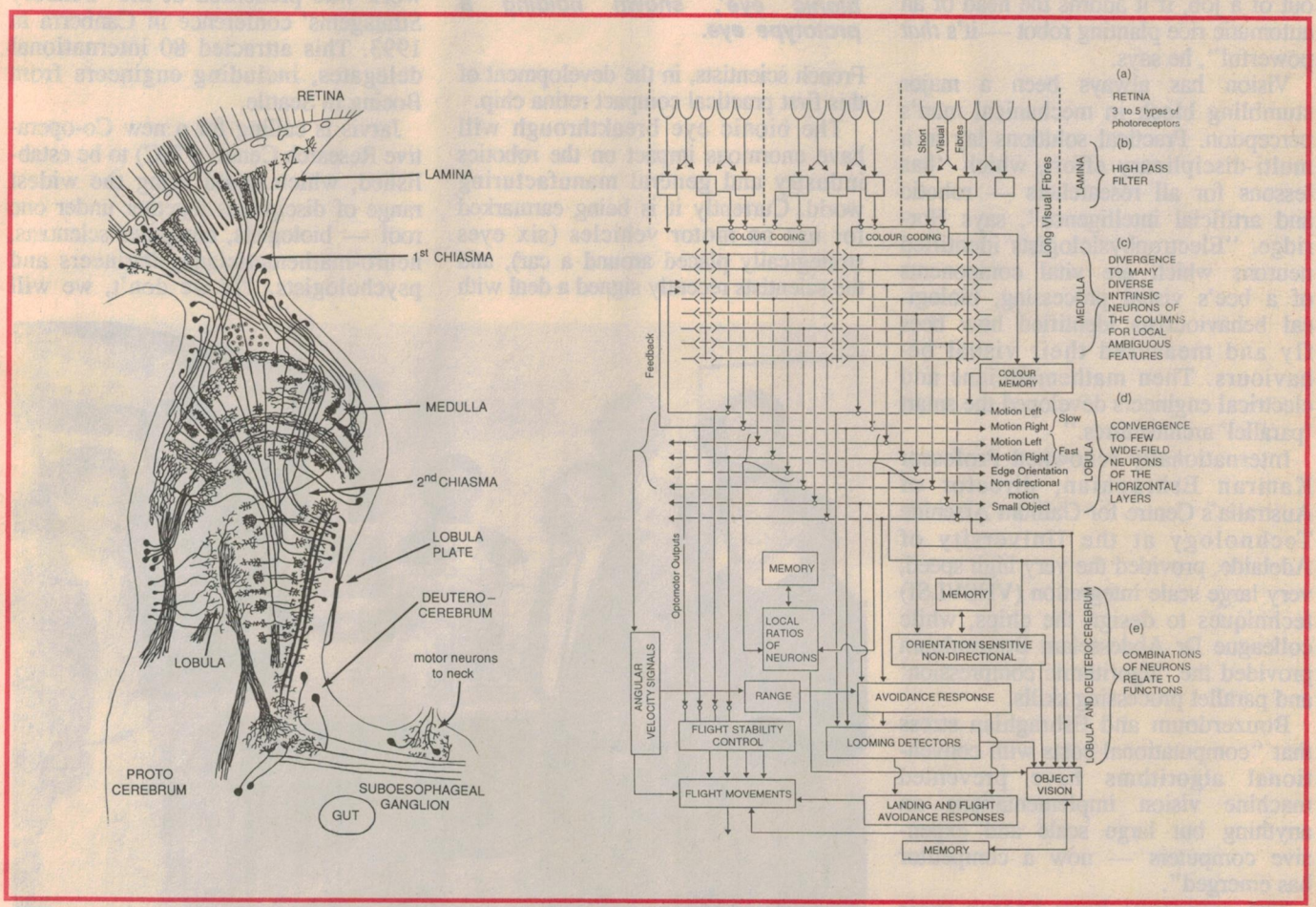
The microscopic motors are the first step on the road to producing a miniature robot. "If we also develop low cost micro-inertial navigation systems (INS) the range of applications is mind-boggling for controlling tiny robots", says Dr Zmood.

But perhaps the most exciting robotics breakthrough to emerge on the world scene in recent times has occurred in Australia, in the production of *bionic eyes*.

Robot vision

Using biological metaphors, Australian National University scientists have created the world's first bionic eye. This comprises 60 integrated photodetectors on a chip — six chips of which can be arranged to allow 360° vision. It is based on the principles of insect vision.

The belief was that machine technology would do very well indeed if it could perform as effectively as large insects such as honey bees, which fly expertly among obstacles in a three-dimensional cluttered world.



A biological diagram of a bee's eye compared to a block diagram of the bionic eye developed by the ANU's Centre for Visual Sciences and the microchip team at the Department of Electrical and Electronic Engineering, at the University of Adelaide. According to Prof Horridge, the applications of their bionic eye are 'endless and diverse'.

Tomorrow's Robot Bizarre

The new robot eyes are the work of a 30-strong Australian science team, led by Professor Adrian Horridge and scientists and engineers of the Australian National University's Centre for Visual Sciences, and Professor Bob Bogner's microchip-design team at the Department of Electrical and Electronic Engineering at the University of Adelaide.

According to Horridge, the applications are 'endless and diverse', ranging not only from aids for the blind and car bumper eyes for collision avoidance, but all robots and machine tasks. He emphasises that when the cheap eyes are coupled to robots and machines, they will do the typical nasties like nuclear reactor work and decommissioning of reactors, chemical contamination, seabed mining, and work in too hot or too cold environments, as well as virus handling, quality-control of production and even 'rubbish collecting robots'.

"It will also put all the women of Asia out of a job, if it adorns the head of an automatic rice planting robot — it's *that* powerful", he says.

Vision has always been a major stumbling block in mechanical man's perception. Practical solutions lay in a multi-disciplinary effort, which "has lessons for all researchers — robotic and artificial intelligence", says Horridge. "Electrophysiologists identified neurons which are vital components of a bee's visual processing, biological behaviourists identified how bees fly and measured their visual behaviours. Then mathematicians and electrical engineers developed the smart 'parallel' architectures."

Internationally renowned Professor Kamran Eshraghian, director of Australia's Centre for Gallium Arsenide Technology at the University of Adelaide, provided the very high speed, very large scale integration (VHSVLSI) techniques to design the chips, while colleague Dr Abdesselam Bouzerdoum provided the 'algorithmic compression' and parallel processing skills.

Bouzerdoum and Eshraghian stress that "computational costs with conventional algorithms have prevented machine vision implementations on anything but large scale and expensive computers — now a competitor has emerged".

The scientists have beaten their American counterparts, such as microchip wizard Carver Mead and his team at Caltech, California, and also

Prof Adrian Horridge, 'father of the bionic eye', shown holding a prototype eye.

French scientists, in the development of this first practical compact retina chip.

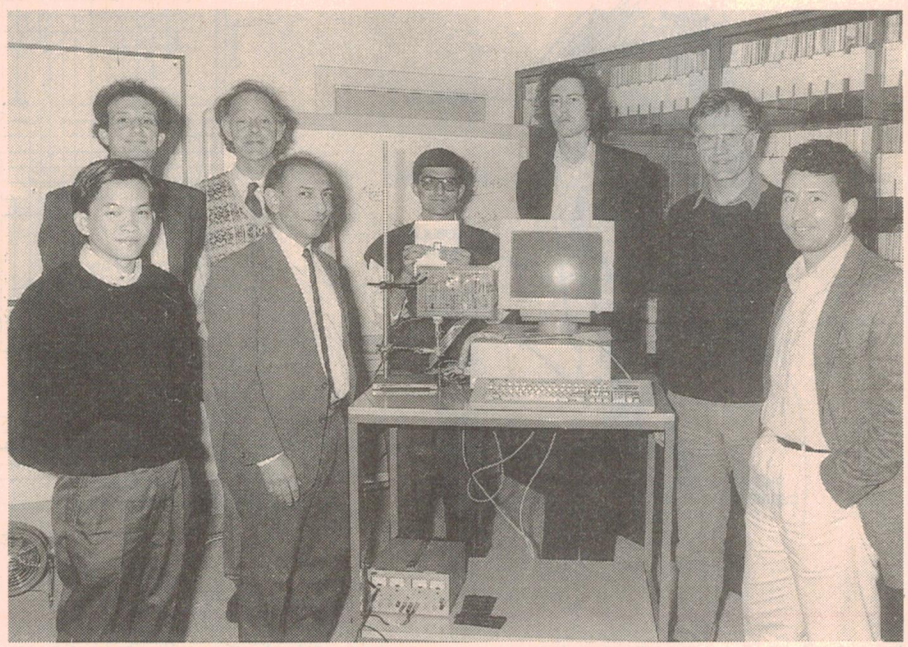
The bionic eye breakthrough will have enormous impact on the robotics industry and general manufacturing world. Currently it is being earmarked for use on motor vehicles (six eyes strategically placed around a car), and the scientists recently signed a deal with a motor vehicle corporation. But the 360° looking eye (six chips) could also be used in smart traffic lights, surveillance or anywhere that cheap visual analysis of movement is required.

The scientists are now looking at the bee brain, where pattern/object recognition occurs, so as to build the next generation of 'smarter' eyes.

As Engelberger stresses in his robotic enterprise, "the secret to success is sensory perception — I can say it over and over — just get good sensory perception". His service robots in hospitals, which deliver supplies and food in 12 story buildings, are effectively blind and currently using radar-like sensors to navigate. Engelberger is keen to test out the inexpensive Australian eyes.

Professor Ray Jarvis of the Intelligent Robotics Research Centre at Monash University felt a little of the growing power of the new breeze that is blowing across robotics when the new vision work was presented at the 'Sensory Stratagems' conference in Canberra in 1993. This attracted 80 international delegates, including engineers from Boeing in Seattle.

Jarvis is calling for a new Co-operative Research Centre (CRC) to be established, which could bring the widest range of disciplines together under one roof — biologists, computer scientists, neuro-mathematicians, engineers and psychologists. "If we don't, we will



The bionic eye chip design team: back row, D. Abbott, A. Horridge, A. Moini, A. Yakoleff; front row, X. Nguyen, K. Eshraghian, R. Bogner and A. Bouzerdoum.

miss the applications boat again", he says. Jarvis works at Monash on numerous robotics projects, including a robot lawn mower.

And last, but not least, are the 'virtual' robots, another technology excellence from Australia that has won international recognition.

Virtual robots

Just as people are coming to grips with the physical realm of robots, along comes an idea so revolutionary that other robotics visions almost pale into insignificance: What if you take the brain completely away from the robot, and stitch it into a totally different task-oriented environment?

This is the new virtual robot, and it is being placed into the brave new interconnected 'nervous' architecture of the communications, information and knowledge age.

Virtual here means 'virtually a robot', as much as it means a brain that can cope with the new reality of our changing desires to simulate the structural complexities of human intelligence and their commercialities, rather than emulating human movement and behaviour.

Virtual robots, also known by the aliases of 'real brains' and 'artificial agents', are the idea and vision of Dr Michael Georgeff, Director of the Australian Artificial Intelligence Institute (AAII) in Melbourne. While some may abhor the thought of assistant-brains and manager-brains, this virtual robot has more flexibility and applicability than its physical cousins, for tasks which Georgeff calls 'detail handling' and 'decision making'.

His first virtual robot has been supplied to NASA to manage malfunctions on the Space Shuttle. He also bid to supply the R2D2 brain, called a 'Pilot's Associate', for the US Defence Department's new military aircraft. As one Pentagon official said, the PA must perform thousands of mission, aerodynamic, and navigational tasks per second — "tasks that would normally require 10 to 20 humans".

Dr Gustav Meglicki of the Australian National University's Automated Reasoning Program says that Georgeff's new robots are an achievement that "all Australian's can be proud of — he has developed a generic robotics software that will be used from this point onwards on all NASA robots wandering out there in space, and for limitless other applications".

Georgeff has built a number of virtual robots which include the OASIS assistant for Air Traffic Control, currently being trialed at Sydney Airport to help in the 60-plane-an-hour congestion and to reduce workload of human operators. Others are being developed for medical anaesthesia tasks, military flight simulation, beer line production and for managing Telecom's complex networks.

Georgeff says that these virtual robots are 'born' with different sensors and different end-effectors (virtual hands), and work in a different environment, but they still have to make decisions and act. They could be sitting there watching chemical processes, watching transactions on the stock exchange, running factories and telecommunication networks.

"That view is very important because the physical robot is in fact a very narrow view. The physical robot is a complex and difficult development task, and much more capital intensive because it is very hard to build good sensors, especially if vision is important and hard to build effectors to emulate human capabilities."

"Both sides are interesting, intellectually, and real robots can be good for very specific jobs like Trevelyan's sheep shearing robot, but their applications are not as diverse as virtual robots. In fact there are a million tasks that you can build these virtuals for, which can make a huge impact on the way we do things in the world. They fit perfectly into the Australian landscape of infrastructure and business", according to Georgeff.

In terms of current development, Georgeff compares robo-OASIS to the primitive, task-limited 'golden delicious' apple picker of France, but as more is learnt about what he calls 'beliefs, desires, and intentions', evolution will occur.

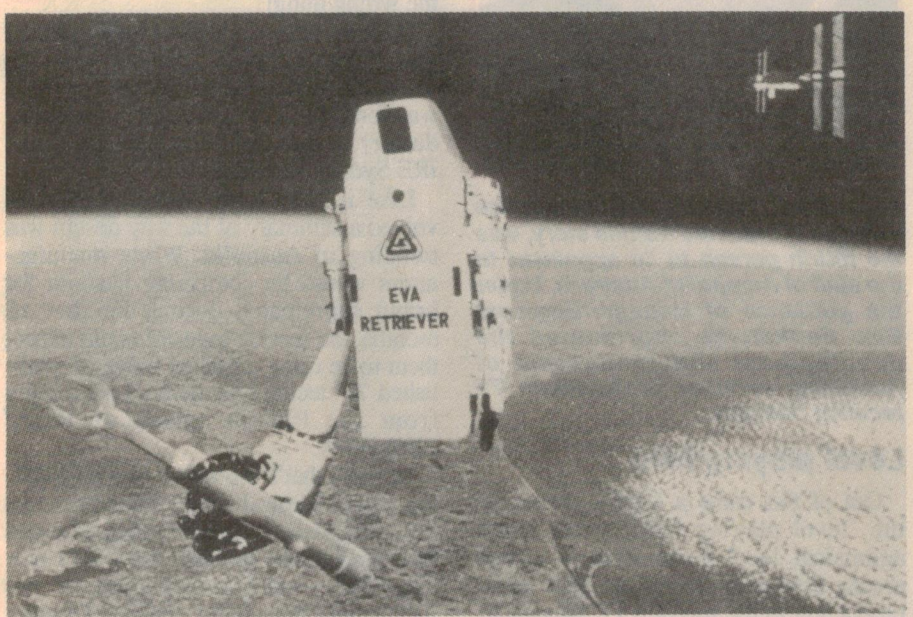
In theory, the virtual robots can be the size of HAL, the living spaceship in the film *2001*, which is sensate over its entire structure — or even larger to sense, feel and manage dynamic cityscapes, airscapes, and perhaps even future Japanese 'technopoli'.

This image of a brain-only world, hard-wired to the nervous-like architecture of cities, is both awe-inspiring and frightening — and another angle on Mary Shelley's vision (author of *Frankenstein*, 1819). Who decides, for instance, which human tasks represent the 'detail' functions to be replaced by virtual robots, and those that represent the 'decision-making' functions to be replaced?

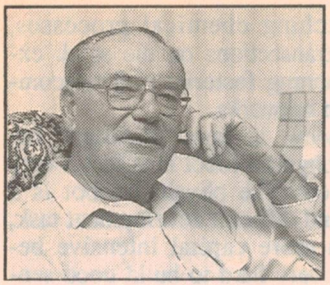
Georgeff, representing the virtuals, wishfully says "it would be great if we could get people out of the detail business, which they are terrible at, and into the creative part which they are good at".

One thing is certain. Only the tip of the robot world has been sighted in this report; the submerged part also includes the Japanese Industrial Robot Association's 'personal robots' which will, by the beginning of the 21st century, 'serve people in every aspect of their lives', according to a recent JIRA study.

We'd better get ready for the second coming, it seems. ❖



An artist's representation of a space station 'EVA retriever' robot for in-orbit repair work, which will use some of the concepts developed by Dr Michael Georgeff, director of the Australian Artificial Intelligence Institute in Melbourne.



When I Think Back...

by Neville Williams

Stromberg-Carlson, Admiral and the battle they both lost — 1

In the mid 1950's, anticipating the introduction of television broadcasting, the American Admiral Corporation set out to capture a share of the Australian TV market. They produced a lot of monochrome receivers, only to disappear from the local scene a few years later. What happened, and their traumatic price war with Stromberg-Carlson, forms the subject of this two-part article.

Facing the preparation of the article, I felt somewhat hesitant — partly because of its controversial nature and partly because, as distinct from rumour, matter-of-fact information about Admiral has been rather hard to come by.

To appreciate why this should be so, it is necessary to recall the mood of Australia's radio/electronics industry in the early fifties.

Faced with the prospect of launching into TV receiver production, established local radio manufacturers were apprehensive, to say the least. TV production would involve expanded facilities, more complex technology and a higher level of staff training.

The per-unit production cost would be greater, as also would be the outlay for marketing, warranty and field service. If they got it wrong, the end result could be catastrophic.

In the lead-up phase, there was endless conferencing between industry authorities to determine the channels and other transmission standards; to nominate suitable intermediate frequencies for TV receivers and to ensure that they would be protected, as far as possible, from interference by other RF emissions.

A key issue for the manufacturers was the matter of picture size — involving, in turn, the choice of picture tube and its demands in terms of deflection circuitry and EHT supply.

At best, a multiplicity of screen sizes could confuse buyers and hinder sales. At worst, it could increase the risk of individual manufacturers running into trouble by backing the wrong size or trying to market diverse models.

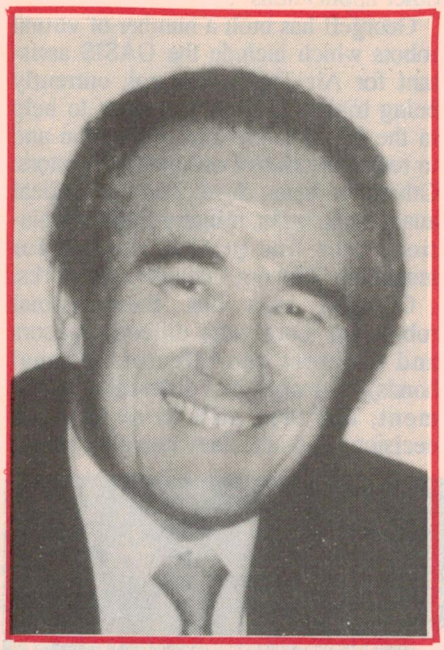


Fig.1: Fred Hawkins, to whom we are principally indebted for this story, was the fourth person to be appointed to the staff of Admiral of Australia. Under the guidance of Manager/Engineer Eric Fanker, he coordinated the development and production of Australian versions of American TV receiver designs.

Level playing field

Out of this came a 1950's version of the 'level playing field': after much agonising, local manufacturers agreed among themselves to restrict their initial production to the use of a 17" (diagonal) screen (43cm) using a long-neck 70° deflection picture tube. This, along with agreed intermediate frequencies would ease their immediate dilemma and also clear the way for component suppliers to market standardised tuners, IF strips, deflection components, etc.

Valve manufacturers and distributors also fell into line, because it would help rationalise their stocks of valves, glassware and picture tubes.

Not everyone supported the plan, however, not the least because it promoted the easy option rather than state-of-the-art technology. Typical of these was a leading local test equipment designer/manufacturer, who was refused access to 21" cathode ray tubes lest the supplier be seen to be doing the wrong thing!

With industry contacts in both camps, I was exposed to both points of view. To cap it all, as an ostensibly neutral party, I was formally invited to present an introductory lecture on TV technology to the IRE Sydney Division.

Like it or not, this automatically involved a summary of the way design was trending in Australia. While manufacturers would be competing head-on for brand supremacy, during the first 12 months, the service industry could expect them to be using a limited range of established 70° technology derived principally from the Philips group or RCA/AWA/AWV.

At least, that's the way it was all trending until Admiral made their presence felt. Established manufacturers resented their appearance because they were bidding for a substantial slice of the Australian television 'cake'. Dealers were apprehensive because they might support competition in existing authorised areas. Worst of all, Admiral

of Australia Pty Ltd owed no allegiance to the aforesaid local manufacturers' design criteria.

The big (trade) freeze

Back in 1950, Admiral Corp (or Continental Radio & Television Co) had been offering a half-dozen or more domestic TV sets on the US market with screen sizes ranging from a nominal 12.5" to 19". They had then moved to 21" and 24" models, which they regarded as current state-of-the-art for domestic viewing.

They were not about to turn the clock back, but were planning to launch in Australia with 240-volt 625-line versions of their American 21/24" models. The tuner would be reworked to suit Australian channels, but they would probably retain their existing 21MHz IF system.

Some prospective purchasers welcomed the option of a larger screen, but their plaudits were overtaken by a virtual tidal wave of rumour and ridicule.

It was said that Admiral Australia intended to use a transformerless power supply. Having in mind the reputation of 1930's-style transformerless 240V radio receivers, a large transformerless TV set would be potentially lethal ('bodies on the carpet'!). And think what might happen if the insulation between chassis and aerial was to be breached ('bodies in the ceiling', as well!)

Another report was to the effect that a certain State Government had anticipated the situation by ruling that Admiral receivers could only be installed in that State if they were coupled to the mains via a 240/240V isolating transformer.

It was also said that by using a non-standard IF system, Admiral receivers would not have a protected IF channel. It would be anybody's guess what unwanted transmissions might break through to compromise the picture and/or sound.

And did you know that you'd be too close to a 21" screen, in a normal lounge room, for comfortable viewing?

What's more, can we really believe that Admiral are going to use new Australian parts? No sir! They'll ship out crates of factory left-overs and use them to build a superseded model. And where will that leave us when they break down, or when the non-standard valves or picture tubes fail? Up the proverbial creek, without a paddle!

Surprise: they worked!

There may have been more, but the above are what I could remember and follow up by checking with service contacts who were around at the time.

In the process, I was able to verify that *none* of the above rumours had been borne out in practice. Looking back, no one that I came across had any recollection of Admiral receivers being particularly lethal (no bodies) or unacceptable to any State Authority, or especially prone to RF interference, or impossible to service. They were just ordinary sets, that could be installed, watched and repaired in the usual way!

Fig.2: Formerly the Chief Engineer of Thom & Smith/Tasma, Eric Fanker became the driving force behind Admiral of Australia. He is said to have seriously warned other manufacturers against launching with obsolescent receiver technology, but his advice was ignored.
(By courtesy of Mrs Circie Fanker).

Philip Watson, a former confrere on this magazine, used to supervise and edit the 'Serviceman' articles in those days. Consulted about Admiral receivers, neither he nor I could recall any pattern of complaint or criticism.

Doug Brown, a reader who was a 'Radio Department' Manager for Grace Brothers, said that they handled a range of monochrome TV receivers, including Admiral. He had a vague recollection of service personnel mentioning something about over-scanning, but there was no question about their reliability.

I also talked to James (Jim) Yalden, another former *EA* staff member, who currently operates a radio service business, based at Milton on the NSW South Coast. When he took over from the late Peter Gatehouse, he found that Peter had been selling Admiral TV sets in the area from day one, for which Jim became responsible.

Admiral TV were sets were certainly *not* transformerless, he said — except for a couple of stray compacts, which he thought were probably imports. The rest had conventional transformers and presented no problems in terms of either reliability or service.

He still had service literature on file and, while thumbing through it as we were talking, he was reminded of something else: "Ah yes; far from being of dated design, they used printed circuit boards and were possibly the first in Australia to do so".

As for an interstate ban on transformerless TV sets, Jim Yalden had heard of it — but he was also able to pin it down to Victoria and to ring a nearby acquaintance who had once worked for the SECV — the State Electricity Commission of Victoria.

The SECV, he was told, had been concerned by electrolysis in earth return circuits caused by the passage of direct current, occasioned by their extensive tram system. They had discussed the possibility of further damage that might result from the use of transformerless TV receivers. They were common in Europe and might conceivably be imported in quantity by Australia.

He recollected the matter having been discussed within the SECV but, to the best of his knowledge, it had never been the subject of any regulations, and certainly none specifically directed against Admiral.

One could only presume that, back in the fifties, having decided that they disliked Admiral for any reason, an inordinate number of people had been prepared to disparage Admiral receivers on the basis of what they'd supposed or heard, as distinct from what they knew to be true. On that basis, I felt that we owed it to the company to present the story from their point of view.

In fact, the story came to me from Fred Hawkins of Castle Hill, NSW, who had worked as an employee of both Stromberg-Carlson and Admiral, before joining IBM. Strombergs have featured in these pages in earlier issues, with correspondents highlighting conflicting aspects of the story according to their period of service and their role in the organisation.

Fred Hawkins' term of employment came later in the piece, and leads into to the monochrome television era, which saw a marketing lapse serious enough to scuttle what had previously been a large and enterprising company.

It is appropriate that I repeat the whole of Fred's story, because it complements

and qualifies what has already been published about Stromberg-Carlson and leads logically into the emergence of Admiral Australia and to the rivalry and misfortune that sank them both.

Fred Hawkins' story

Fred says that by Christmas 1946, he had sat for his Leaving Certificate, gained his A.Mus.A. and was working as a professional musician. He was interested in radio technology, however, and was hoping that his Leaving Certificate pass would be such as to qualify him for a cadetship with AWA.

At that point, he noticed an advertisement for process workers at Stromberg-Carlson and duly applied, explaining his interests and ambitions. They responded with a job offer, stating that they could provide similar work experience to AWA but with process workers' wages and without the binding relationship of a formal cadetship. It attracted him, and he signed up.

He spent his first year learning to build radio sets, align them, fit them into cabinets and pack them into boxes. Then he learned how to weld, paint, plate, use presses and lathes, wind coils and transformers, build tuning gangs and speakers, assemble motors from 15W up to 1/4hp and to work on the wide range of appliances that the company was producing at the time.

He worked with the plant electrician, learned about cabinet making from an in-house expert, and consulted with Ricketts & Thorpe and Beam Manufacturing in respect to new cabinet designs. He was also taught the rudiments of Production and Inventory Control, and of Time and Motion Study.

Then it was back to the radio production line for the 1950 season, as a leading hand and subsequently as the Line Supervisor — a position he held until he left in May 1955.

During that period, they had been producing radio receivers mainly for sale under Stromberg-Carlson's own brand. Prior to 1950, some chassies had been fitted into different cabinets branded Crosley or Paling Victor, but the arrangements had subsequently lapsed.

No stand-downs

Fred says that the piece-rates referred to by previous correspondents were no longer being paid by Strombergs during the period of his service, nor was there any suggestion of clocking off for toilet visits, or bag searches when leaving the premises.

Around 1951, however, they did experiment with a bonus system to reward production line assemblers for receivers produced over a certain target figure, resulting in a 6% improvement in production rate and a 3% boost to take-home pay.

The scheme was compromised, however, because of frequent interruptions in the mains supply due to post-war system overload. While Strombergs had a stand-by plant of their own, the unavoidable switch-over time still affected the production flow.

More than that, suppliers such as IRC, Morganite, Ducon and UCC were having similar problems, which delayed the delivery of essential components.

Despite this, and I quote from Fred's own text: "By the norms of the day, people were looked after and happy in the service — in direct contradiction to some of your other correspondents."

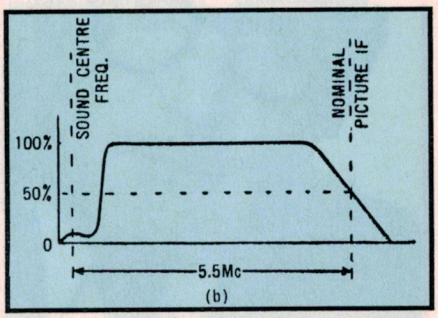


Fig.3: From our own 'Course in Television' in September 1956, an idealised IF channel pass-band for a normal intercarrier TV receiver. At the time, the sound IF would have been at 30.5MHz and the picture at 36MHz on a slope from 35.25 to 36.75MHz.

"I can assure you that every step was taken to minimise the enormous degree of seasonality in the marketplace, by pioneering off-season products and by building seasonal products for stock during the radio off-season."

"Also, we met the big peaks of seasonal production with overtime rather than by extra staff."

"Between 1950 and 1955 I did the hiring and firing, and do not remember laying people off for seasonal reasons."

Fred adds that, on occasions, they would divert the assemblers to a non-radio fill-in project, which not only kept them 'in a job' but also provided a break in the everyday routine.

He also set up an auxiliary production line, intended for batches of 500 to 1000 units, which could be used to build production prototypes, or deluxe models which did not justify allocation to the primary assembly line. In practice, it offered a helpful way to 'balance out the seasonality of the mainstream products'.

In a better light

Summing up, Fred says — and again I quote: "One thing that hasn't been stressed is that Stromberg-Carlson was the industry leader because they were highly motivated and determined to be the first with the best."

"There were a lot of very good people there and they were team players. Also, the technical leadership was outstanding. S-C introduced many new processes in Australia, such as presses with the capability of pressing out large pressure cookers, expanded aluminium sheet, hammertone paint, and polyester finished cabinet work."

"For thirty years, their heaters and fans were industry standard. They made the first Australian-built record changers, the first personal portable radios and the first post-war table and floor model radiograms, etc."

"With the Nally Co, S-C introduced the first 'leading edge' injection moulded products. They worked closely with the valve companies and were always among the first users of their products, often beating competitors to price reductions."

"The advertising was professional, even if sometimes gimmicky (e.g. 'There is no tone like OVALTONE')."

Fred Hawkins begs to differ from those who have, to date, attributed S-C's technical leadership to Les Bean. That's not the way he saw it, he says, during his period of service. The credit should go rather to Allan Scott, Works Manager and Chief Engineer.

"He had an amazing knowledge of the engineering disciplines and was the real focus of everything that happened. He lived with every new process and every new product."

"Al Freedman decided the direction and Allan Scott made it happen."

The passing years

Concerning top management, Fred says that, in the early fifties, by contrast, Les Bean seemed to fill his days with personal pet projects:

"For example, the company built him an amazing truck/caravan combination with a pedal-operated toilet which literally took man-years to develop. The big day finally came and away he went, but had to be rescued the same day when the suspension failed."

"It was returned to its shed and his attention transferred to fitting out two 47-225 black Holdens — one for him and one for Mabel — with personalised plates, which were unusual in those days.

The Holdens were fitted out with every conceivable extra, including a fool-proof burglar alarm — the first one I had seen at the time."

"Les B. wandered through the plant (occasionally) but his interest was not in the important things that were happening — rather in things like 'Who left that box sitting there, boy?'."

Fred says that such was the case when he left in 1955, and he was therefore surprised to read (in *EA*) about Bean's deep interest in conveyor belts, etc., which were installed some three years later. With hindsight, however, he tips that Allan Scott's subsequent resignation as Works Manager and Chief Engineer must have catapulted Les Bean back into the saddle — by then a very demanding situation.

Move to Admiral

For Fred himself, the prospect of change was heralded by an article in his local paper during May, 1955. The Admiral corporation, it was said, had formed a joint venture company with General Industries to set up Admiral of Australia Pty Ltd, with the intention of building radio and television receivers.

To that end, they had purchased 19 acres of land and had submitted plans for a factory building to the Bankstown Council. Fred had married and moved into the same area some 18 months previously, and it sounded very interesting.

Research showed that General Industries was the holding company for a number of manufacturing concerns, of which the most notable was Metters.

Fred accordingly fired off a letter, explaining his position and requesting an interview with whoever was responsible for the Admiral of Australia venture.

The surprise result was a phone call from Eric Fanker, who had been well known to them at Stromgerg-Carlson as the brains behind the Thom & Smith 'Tasma' brand name.

It turned out that General Industries also owned 'Rotafrig' (cylindrical refrigerators with rotating shelves) and had allocated the fledgling Admiral organisation temporary accommodation on the mezzanine floor of their rather tired refrigerator factory in the inner Sydney suburb of Waterloo.

Eric Fanker had been named General Manager of Admiral of Australia and he duly introduced Fred Hawkins to his only two employees. The first was a well respected and competant Radio Engineer Eric Christian — universally known as Eric the Christian because of his ever-readiness to communicate his devout beliefs. The other was a real Scottish engineer, to whom nothing mechanical was a problem!

Fanker had brought both men with him from Tasma. Fred was interested in the proposition and so were they in him, such that he became the fourth employee of Admiral Australia in June 1955. In accepting the position, Fred told me, he was conscious of the fact that their new factory would be handy to where he already lived.

The overall plan was to get Australian Admiral receivers to the market within 15 months, in time for the commencement of TV broadcasting.

To get the Admiral brandname established before that, they planned to launch a range of small radio receivers by June 1956. It would provisionally include a four-valve portable, a larger five-valve mantel set and a mantel/clock radio in the then popular Swedish styling.

The receivers would be housed in state-of-the-art moulded cabinets and the internal circuitry would feature printed circuit board construction. Fred Hawkins' job was to get these receivers to market.

In conversation, I mentioned to Fred that Admiral had been credited with pioneering the use of printed circuit boards in Australia. Was this the case, and did they produce them in house?

As Fred recalls, the initial batch were imported, after which they were manufactured locally — probably by RCS. This raised the question as to whether, in the process, Admiral may have propelled RCS into a field which has since become their main activity.

When I rang Bob Barnes, RCS' current proprietor, I unearthed what was to me an unknown and intriguing tale. RCS' involvement in circuit boards dated back to the early 1940's! (See panel). He added that Admiral may also have been supplied by Pye Australia, which has since been absorbed by Philips.

The very next par in Fred Hawkins story suggests why he is hazy on this particular point. He says that he had been working on the receiver project for a few weeks only when they were joined by an engineer, ex-AWA, who had been studying TV technology in the USA. His task was to develop the Australian Admiral range.

Unfortunately, there was a clash of personalities between Eric Fanker and the new recruit, and within a month or so of joining the team, he was gone.

Fanker's response was to pluck another engineer from Tasma to take over the radio receivers, and to move Fred Hawkins to TV development. Fred admits that his knowledge of TV technology was 'sketchy' but Eric Fanker was a good teacher and he had no option but to be a diligent student, burning up lots of 'midnight oil'.

(To be continued) ❖

Wartime Printed Circuit Boards?

In his biography *My Life With Printed Circuits*, Paul Eisler says that he studied electrical engineering and technical physics at the Vienna Technical University but being a Jew, found it difficult to pursue a related career in Austria/Germany. Instead, he had to earn a living as a printer.

Of an inventive turn of mind, he had taken out a couple of patents and was able to use them to gain an invitation to visit a couple of English firms and, ultimately, a work visa in the UK.

His prime ambition was to develop the concept of printed circuit boards, with the long-term objective of contributing to the Allied war effort. British companies, however, stressed by the Blitz, were not keen to displace existing designs and methods.

The best Eisler could do was to join forces with a struggling firm of music printers, who welcomed the chance to undertake something with a higher wartime priority. In the resulting context of 'Technograph Printed Circuits' Paul Eisler and Gustav Parker, an old friend from Vienna, gradually developed the technology of laminating, producing thinner foils by electrolysis, printing and etching. They then moved on to printed inductors, thermal mats, etc.

Their techniques were publicised by NBS (US National Bureau of Standards) and, while it brought them little financial reward, they were applied in proximity fuses for anti-aircraft shells. As such, they helped turn the tide of war, by their effectiveness against bombers and V1 missiles.

It would appear that confidential information about Eisler's research reached Australia via the Pye Group, which presumably examined its potential in collaboration with Ron Bell of RCS. Ron Bell, in turn, appears to have verified the processes, after hours, in a private darkroom installed in the garage at his own home.

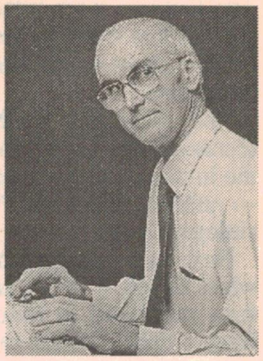
His wife, Olga, confirms that he had some such project in hand during the war years, involving copper etching etc., along with discussions with Pye Australia. Bob Barnes, the present proprietor of RCS puts the date down as 'probably 1943' and claims that Australian-made PC boards found their way back to the UK, under tight security, presumably through the Pye/Eisler link.

Only later, when Ron Bell came up with automated processing, did he major on circuit board production, such that RCS can now claim to be the oldest surviving large-scale manufacturer of circuit boards in the world — dating back to the early forties!

According to Bob Barnes and Olga Bell, either or both RCS and Pye could have supplied Admiral with PCB's in the mid 1950's...

FORUM

Conducted by Jim Rowe



Complaints from both TETIA and a migrant, both believing we owe them an apology...

I have quite a mixed bag for you this month, with the first item a complaint from TETIA that I have damaged the reputation of its members. There's also a letter complaining that our Serviceman has insulted people for whom English is other than their native language, another comment about plug-pack supplies, and an interesting report from the former conductor of this very column, suggesting that as we all get older it isn't only our *hearing* that loses its high-frequency response.

First things first, though. You might recall that in the July column, I printed a letter from Robert Heyward, of Canterbury in Victoria, in response to the announcement in our April issue that Jim Lawler, the secretary of TETIA's Tasmanian branch, would no longer be able to provide our Serviceman column with those 'Fault of the Month' summaries of interesting faults and their cures. I added a few comments after his letter, and it turns out that without intending to, I seem to have really upset TETIA members all over Australia.

Very shortly after the July issue was published, I received the following letter of complaint from Jim Lawler himself, who is now apparently the Federal President of TETIA as well as secretary of the Tasmanian branch. It's quite self explanatory, so I'll let Jim explain:

I am very disappointed at the unfair criticism levelled at this Institute in your Forum column of July 1994. I contend that your comments are unfair since you have known for years that I am an officer of the Institute, and you should have been aware of the facts from our occasional discussions on the subject. Indeed, we discussed this very matter during the TETIA/Mitsubishi Seminar at Wrest Point only last year.

Then, I should have thought that you might research the subject in your magazine's own library, in particular the issue of June 1987, pages 36 and 37. There, you would have found all you needed to know, to report accurately about the Institute and its members.

And again, I am disappointed that you have not mentioned the subject to me during any of our frequent phone conversations. It would have been so easy for you to check the facts with me, since I am both Secretary of the Tasmanian Division and Federal President of the Institute.

Your comment about an 'Achilles Heel' is grossly insulting to our members. The Institute's 'Articles of Association' require that every applicant for membership must present evidence that he has passed formal examinations at least at trade level, and has no less than FIVE YEARS full time experience in the industry. Without both qualifications, no person can become a member. Not even your own B.A., B.Sc. and long experience in electronics would qualify you for membership of the Institute.

Provision is made in the rules for persons with lesser qualifications to be admitted as an Associate or Student member. Similarly, a 'Grandfather Clause' allows for the admission of persons who have no formal qualifications, if they have a long and reputable history of full time employment in the industry.

The ignorance displayed by Mr Heyward is understandable and I would be pleased to explain the facts to him if he would care to contact me.

Contrary to your suggestion that we object to 'unqualified' people working in the industry, we have no such objections provided that the persons concerned are totally committed and apply themselves full time to the industry. Our objections lie with the 'backyarder', a person who already has a full time and often well paid job elsewhere while running a part time business, all too often at his employer's expense.

It is the loss of work to these part timers that seriously limits the opportunities for young people in this industry. It is one thing for a man who is out of work to turn to his hobby for income support. It is quite another thing for those greedy operators with an already good income to take for themselves work that might otherwise support an apprentice or trainee.

From the above, you will see that your unwarranted comments about the Institute in the July Forum are quite wrong, and only a full apology will ease the hurt felt by our members. I will grant that the affront was not intentional, but it has damaged our reputation and I look to you to make good that damage.

Well, Jim, it was certainly not my intention to either insult or damage the reputation of TETIA and its members. However since I seem to have done so, inadvertently, I'm sorry. In fact I have a great deal of respect for TETIA and its activities to raise the standards of electronics servicing in Australia, and my comments were in no way intended to reflect adversely on the skills and integrity of TETIA members. My main aim was to draw attention to the importance of practical experience and committment in assessing servicing people, rather than relying on formal qualifications. I'm glad that TETIA seems to agree.

By the way, the article to which you refer was published just before I came back to the magazine; perhaps that's why I didn't recall it as a potential reference. The fact that you were its author may also explain why it's fresher in your memory than in mine. My only other excuse for 'not checking the facts', as you describe it, is that as with many Forum columns nowadays, I prepared the July column at home on a weekend — with inevitably less access to our office library and files.

I hope that your unhappy members will accept the above explanation.

Unhappy migrant

Now let's move on to the second of our complaints — from the writer who feels that our Serviceman has been insulting to people for whom English is not their native language.

I have to admit it's not very often we get complaints about comments made by our Serviceman. The Serviceman column itself has been a regular and very popular feature of the magazine for well over 50 years, starting way back in the December 1939 issue as 'The Serviceman Who Tells'.

In fact, over all the years since I myself joined the magazine in January 1960, I can't remember the column generating any complaints. There might have been the odd quibble about a technical explanation by the Serviceman regarding what had caused a particular fault, but that's about all.

Of course the column hasn't been simply the work of a solitary individual over all of those years. As most readers have probably guessed, it has often been quite a collaborative effort — with various people providing the actual servicing stories, and the final 'tidying up' and preparation often done by someone else.

For some years this final preparation was done by a staff member (former deputy editor Phil Watson did it for many years, before he retired), but in recent years it's been done by one of the experienced service technicians who previously supplied some of the stories.

One way and another, then, and despite its great popularity, Serviceman has until now generated very little controversy. So it's all the more surprising that we've finally had a complaint — and about a few comments made by our Serviceman in his May column, in introducing a story from a reader with the initials 'A.K.'. Just so you'll make more sense of the complaint, here are the Serviceman's comments in question:

How would you manage, writing a technical story in Polish? Or Russian, Spanish, German, or any other language that's not your own? I know that I'd be hopeless, so this contributor deserves more than the usual credit for his efforts.

The story comes from A.K., of Blackmans Bay in Tasmania. I understand that he came to Australia from Poland only seven years ago, knowing virtually no English. Since then he's converted his technical knowledge from Polish to English, and learned to speak and write what is regarded by many as one of the world's hardest languages.

We have heard from A.K. before in these pages, but on that occasion he told me the story over the phone. This time he wrote it out for me, and his efforts to express himself deserve the highest credit. Unfortunately, his English is not yet good enough for direct transcription, so I must do my best to tell his story, in my interpretation of his words.

I hope that A.K.'s story will encourage other newcomers to Australia to tell us of their experiences. So long as I can understand what you are saying, I can re-write it into acceptable English.

Well, there you are. A fairly innocuous set of introductory comments, I would have thought, and quite sympathetic to the problems faced by people like A.K. who have been forced to acquire another language. But somehow, these apparently innocent comments by our Serviceman have really upset Mr Fortunato Epifani, of Endeavour Hills in Victoria. Here's his letter:

I am a migrant who has been living in Australia for two years now. I am not Polish and I came here without knowing any word of English. Now I am writing to tell you and everybody else a few things that in my point of view are wrong.

In the column THE SERVICEMAN of May 1994 issue, you asked How would

migrants manage, writing a technical story in English? You would not feel anything different writing in another language if you were part of another country for many years. I will tell you how you can manage to writing in another language; you have to know the 'GRAMMAR' which is the key to write in any language. You can utilise books, dictionaries, magazines, catalogues, etc to find out unknown names of technical parts. By knowing grammar you are able to write anything you want to.

It is written in the same article '...Since then he's converted his technical knowledge from Polish to English, ...' It is a must to say that the 'TECHNICAL KNOWLEDGE' cannot be converted between languages, it is knowledge. A circuit in Polish is exactly the same circuit in English or in any other language.

It is also written '...So long as I can understand what you are saying, I can re-write it into acceptable English...' It sounds to me that ALL MIGRANTS CAN NOT WRITE IN YOUR (OUR) LANGUAGE WHICH IS NOT EXACTLY TRUE. MIGRANTS ARE NOT ILLITERATE AS SOMA AUSTRALIAN PEOPLE MAY THINK. NOT MANY AUSTRALIAN PEOPLE CAN SPEAK IN ANOTHER LANGUAGE. MANY MIGRANTS (I AM NOT INCLUDED) CAN WRITE IN ENGLISH MUCH BETTER THAN MANY OF THE NATIVES SPEAKERS.

Migrants feel 'disqualified' from writing to a magazine, probably because they feel they will be treated as illiterate.

Because you think I can not read or even understand English, I am seriously thinking if I should buy the magazine.

This letters must have sounded aggressive but it is not being written to be so. I do not mind if the letter is published or not. I am hopping that you can understand what I am saying. Has this letter been written in an 'ACCEPTABLE' English?

Thank you for your comments, Mr Epifani. I don't think any of our readers would have had significant problems understanding what you have written, even though there are one or two 'rough edges' — possibly due to the typing mistakes most of us tend to make, regardless of our original language. Normally I would have corrected these automatically (that's one of my functions), but in this case I decided not to, as it might perhaps have seemed patronising and upset you further.

I don't know what other readers make of Mr Epifani's complaints, but I must confess to being rather mystified. Somehow he seems to be determined to find fault with the Serviceman's comments, reading insults into them when I feel sure that exactly the opposite was intended.

Basically, as I think most people would agree, the Serviceman was expressing his appreciation for the difficulties faced by people like A.K. in having to master a difficult new language, and his admiration of them for achieving so much in a relatively short time. His only real qualification to this was in suggesting that in A.K.'s case, some re-writing had still been necessary in preparing the story for publication.

How Mr Epifani has managed to turn this into some kind of suggestion that 'no migrants can write acceptable English', I have great difficulty in understanding. And I'm even more puzzled that he seems to have extended the misunderstanding even further, to the point where he believes he's now unwanted as a reader!

I can only assume that something in what the Serviceman wrote has somehow led Mr Epifani to assume the exact opposite of what was intended, and that as a result he has misinterpreted everything that followed.

So please, Mr Epifani, let me try to clarify the situation for you. Our Serviceman is a very decent chap, and he and I both appreciate the problems faced by people like A.K. and yourself, and admire you for your achievements in mastering a new language as well as you have. We not only value you as a reader, but also as a potential contributor — so please don't worry about sending in contributions. If they seem likely to interest other readers, we're quite happy to perform any minor editing that may be needed to 'polish them up' for publication — *if* it proves necessary (and I'm not saying it would be!). That's what editors are for, after all...

Plugpack voltages

Now let's change the subject. You may recall that in the May column, I published a letter from Martin Tesar of Wantirna in Victoria, raising the problem of poor voltage regulation in many small 'plug pack' power supplies. Mr Tesar had measured some supplies with an open-circuit voltage up to 60% higher than their nominal voltage on load, and had written to warn other readers of the risks of equipment damage from this order of poor regulation.

In commenting on Mr Tesar's letter I discussed some of the likely factors responsible for this poor regulation, and also suggested ways around the problem — such as using one of the more expensive regulated plug packs, or fitting a regulator to the equipment itself.

These comments have now brought a response from another reader, Mr Ron Voller of St George's Basin in NSW. And as you can see, Mr Voller has another suggestion:

This is my first letter to you — I am a fairly frequent correspondent of Peter Phillips's, but the plugpack item was in your own Forum section of EA (May 94).

I have had the same problems — in one case (a Dick Smith masthead amplifier) the excessive supply voltage appeared to cause instability. My cure was a series resistor in the 240V AC supply. Of course it was of adequate wattage to withstand an output short, and was enclosed for safety. In another case a 15 watt pilot lamp was found suitable.

Interestingly the temp/resistance coefficient of this form of resistor (incandescent lamp) makes it behave much like the 'barretter' resistor lamp used to control the filament current in AC/DC variable-voltage supply receivers, back in the days of steam radio. This was brought home to me in my (pre-war) teenage years, when trying to substitute a series string of pilot globes for a kaput HT 'voltage divider' resistor. The current remained almost constant no matter how many globes were put into the string!

I digress! A strong point favouring the use of a lamp in mains-series as a resistor is that it's an absolute current limiter. We have probably all read of plugpack failures suspected of starting house fires; thinking about the design parameters makes one realise that a plugpack is probably one of the nastiest devices one can leave running 24 hours a day.

The use of a series lamp (choose the lowest wattage that works properly) will avoid heavy mains current ever resulting from breakdown. Simply install a series lamp with a masthead amplifier, NiCad battery charger or similar device and you can leave home for a day or months without fear of the thing developing a brown smell. A 15 watt lamp just can't pass more than 60 milliamps — no matter what! Even a 1000 volt surge can only blow the filament.

Thanks for those comments, Mr Voller. The idea of using an incandescent lamp in series with the mains side of the supply is an interesting one, and as you say it dates back quite a long way. I remember seeing examples of those AC/DC valve sets with their 'barretter' lamps inside, when I first became interested in radio and electronics.

I guess it made reasonable sense to use

such a system with series-connected valve heaters, as the lamp's positive temperature coefficient would tend to give automatic current regulation — which is after all what was needed. However it's probably less appropriate with a plug pack, because what we're really after here is voltage regulation. A resistor with a *negative* temperature coefficient would be better, wouldn't it? That way, the resistor would have maximum resistance when cold, having maximum effect on the no-load output voltage and less effect on the loaded output.

Still, an incandescent lamp is certainly a convenient form of mains-rated dropping resistor, as you suggest. So providing you can select the right value, to pull down the no-load voltage without too drastic an effect on the loaded voltage, it sounds as if it would be worth trying in some situations.

Of course there's the added advantage of reducing the risk of fire or other damage due to a fault developing in the plug pack itself, as you say. The main thing to watch is that the wiring to the lamp should be done safely, as with any mains wiring.

Yellowing vision?

Now let's look at a subject that has probably never been discussed in the magazine before. It's an interesting one, and it has been raised by my former boss and current columnist Neville Williams — who as many of our older readers will recall, also happens to be the founding conductor of this very column. He first launched it, under the original heading 'Let's Buy An Argument', in the September 1950 issue and then went on to present well over 400 episodes before bowing out...

Anyway, the topic he is now raising is this: we're all reasonably aware of the way our sense of hearing gradually deteriorates, in terms of high frequency response, as we get older. But have you considered that much the same thing might happen to another of our senses — sight?

I'll let Neville introduce the idea properly himself, because he has recently gained some first-hand experience. Here's what he has written, in a letter that recently arrived:

Greetings to 'Let's Buy an Argument'/'Forum' from the yellowing pages of history. Editor John Moyle first suggested the idea, I gave it practical expression and it is now being carried on by your goodself — some fifty years later!

Unlikely as it may seem, the reference to 'yellowing pages' conceals an irony of sorts, relating to a subject of which I cannot recall any mention in these columns. In fact, I cannot recall any mention of it ever in an electronics text. Let me explain.

After having enjoyed good sight throughout my working life, I was concerned a few years back by diminishing acuity and evidence of multiple images, mainly involving my right eye. Fiddling with spectacles didn't help and it was left to an opthalmic specialist to diagnose the onset of a cataract which, he said, could be corrected by microsurgery when it reached the stage of 'bugging me'.

He explained that a cataract is not a growth or film over the eye, but a clouding of the lens inside the eye which focusses the image entering the pupil on to the retina at the rear, much like the lens in a camera. Cataracts occur primarily as a heritage of advancing years.

In my case, the right eye was noticeably affected, evidenced by a discernable 'browning' of the lens, as viewed through one of his desktop gadgets. The left eye exhibited only a faint trace of discolouration, but could conceivably present a problem in the future.

As it was, I could see quite well with the left eye but the deterioration in binocular vision did bug me enough to arrange for microsurgery on the right eye. Its objective was to replace the clouded natural lens with a clear plastic substitute, having a computer selected focal length to bring the eye's natural vision to a sharp focus at about arm's length. As such, it would be appropriate, unaided, for routine domestic activities.

The overall focus range would depend, as normal, on the ageing eye muscles, supplemented by 'reading', 'distance' or bi-focal spectacles.

Happily, the procedure went exactly as planned, with no pain or trauma and, as I write this, I do so with a pin-sharp image from the computer screen — and my glasses in my pocket, where they now spend much of the time! I detail this... partly by way of background and partly to reassure any ageing reader who may face a similar dilemma! It's much less stressfull than a session with the dentist.

Now for the real point of this letter: Shortly after the operation, when I removed the protective shield which needs to be worn for a few days, I was conscious of a blurred image from the operated eye, flooded by white light.

As the eye settled down over the next few days, the curtain of white light diminished and a sharper image emerged, noticeably brighter and more bluish than I had been used to. The TV screen gave the impression that someone had fiddled

the red-green-blue adjustments inside, and turned up the brightness as well.

Now three months on, I have three choices:

1. Use my left eye only and see the kind of picture I have been accustomed to;

2. Use the right (operated) eye and watch a picture that has whiter highlights and more intense blues; or

3. Use both eyes (as normal) and leave it to the brain to compose a subjective image half-way between the two.

Nor is this effect limited to the colour TV screen. When they screen a black and white film, the image shows a discernable increase in contrast due to the brighter 'white' areas.

Again, an oil painting on the living room wall has an area of overcast sky which I regarded as somewhat drab. After the operation, the overcast took on a subtle bluish tinge which implied a sunny blue sky behind the overcast.

In the kitchen, the appliances take on a hard white hue through the operated eye, instead of the former rather creamy quality.

When I rang the Hospital Fund to inquire about reimbursement, etc., the man who answered mentioned that he had recently undergone the same operation. Had he noticed the abovementioned effects? His reply: "Now you come to mention it, I have"!

When I queried the surgeon about my observations, he showed no surprise. He explained that people developing cataracts, even in the early stages — as in my left eye — are looking at the world through a yellow/brown filter, the development of which may be so gradual that it passes unnoticed in terms of colour values.

These days, most EA readers are aware of cumulative high-frequency hearing loss with increasing age, although a few golden-eared septuagenarians have seemingly yet to be convinced.

What I am suggesting here is that we may also have to think in terms of a possible high-frequency visual loss, affecting the blue end of the spectrum. As such, it will affect not only blue tones but white, purple/violet shades, and the subtle green/grey and blue/gray fabric tonings that people often argue about.

How widespread the effect may be, I have no way of knowing. All I can say is that it is very apparent from where I sit: behind two eyes — one fitted with a clear artificial lens and the other with a natural lens so marginally affected in terms of acuity that the medicos are in no hurry to do anything about it.

In the meantime, I wonder how many TV and film veterans are even vaguely aware that they may well be judging images as viewed through home-grown yellow/brown filters.

I also wonder how many septuagenarian photographers, artists and critics are aware that they may no longer be evaluating colour balance in the same light as they did in other years.

It may well be that the above questions provide a virgin field for a student or academic on the lookout for a research topic.

Oh yes! there's that initial reference to the 'yellowing pages of history'. When I run a file copy of the text for the 'Think Back' article each month, I print it on A4 sheets that appear a hard, brilliant white through the artificial lens. But if I cover that eye and view them through the other one, they're already cream — not yellow, for sure, but on the way by reason of my own passing years!

Thanks for those observations, Neville, and I suspect you've given quite a few people food for thought. You're certainly in an excellent position now to judge the relative performance of 'ageing natural' versus 'new artificial' eye lenses, aren't you? There can't be too many people in that position — especially with your understanding of physical and electronic phenomena, as well.

I guess we shouldn't find it all that surprising to learn that there's a gradual high frequency loss in vision, bearing in mind what happens with hearing. All the same, I still find it a little intriguing, and somewhat coincidental that the discolouring of the cornea apparently just happens to be in the yellow/brown direction, to attenuate blues and greens more than anything else.

Superficially at least, I suppose it's quite logical. Our skin seems to get darker and less transparent as we age, and often tends towards the colours of blood and muscle; so it's understandable that the cornea would drift in the same direction.

But on the other hand, the energy of light photons at the blue or 'high frequency' end of the optical spectrum is higher than at the red end, so if there's any 'tiring' of corneal tissue, you might expect that it would make the cornea initially less able to transmit the lower-energy photons at the red end, instead of the higher-energy photons at the blue end. You'd expect that in some ways the higher energy blue photons would be able to 'blast their way through', even when the red photons could no longer do so!

Still, it's an interesting effect, isn't it? Perhaps now that Neville has drawn our attention to it, other readers will be able to throw some further light on the subject (sorry about that pun!).

And that's all for this month, folks. I hope you'll join me here again in the Forum, next time. ❖

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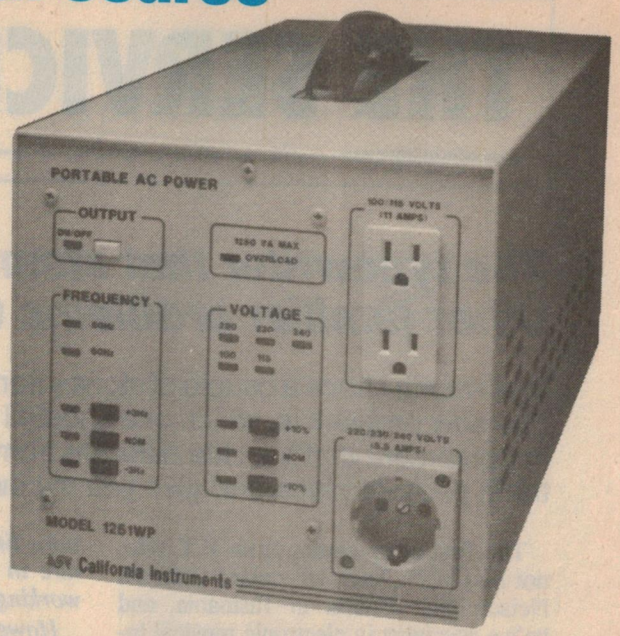

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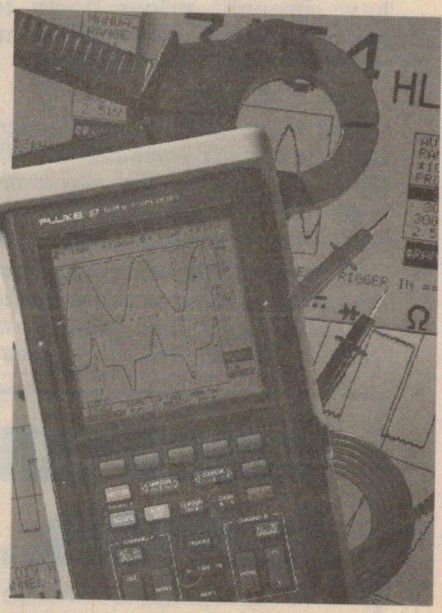

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READER INFO NO. 8

THE SERVICEMAN

The typewriter that stammered, and other familiar problems with unfamiliar devices...

This month I have a couple of stories from my own workbench and a couple from recent contributors. The only problem is, which one should I open with? The two from contributors deal with some faults in equipment that's a little different from our usual diet of colour TV's and VCRs, so I think I'll give them pride-of-place and give you my own stories later.

The first story comes from E.T. (No, not *that* ET!). This E.T. comes from Mt Nelson near Hobart in Tasmania, and he's a specialist in electronic musical instruments such as organs, synthesisers, guitars etc. However, this story is not about a musical subject.

It's actually about a simple electric typewriter — an example of a device that has become commonplace in many homes since developments in electronics have brought prices down to a reasonable level (even though E.T. might not agree with that last comment).

Here is his story...

This is the story of my Fordigraph typewriter/printer, purchased in 1985 for $850. (The same machine was available under the Towa and TEC brands, for $450. Guess which price Muggins paid?)

My original intention had been to modify the machine so that it would not cancel a typed line upon pressing 'return'. This allowed me to print the same line over and over — a useful feature in some of the applications I was working on at the time.

However, apart from a few user instructions, there was no technical information supplied with the machine. I had to insist long and hard before I managed to get a few relevant pages from the technical manual, out of the distributor!

That modification was relatively easy. All I had to do was to interrupt the RESET or INITIALISE pulses to the microprocessor on pins 4 and 6. Since then I've not had reason to refer to the manual — until recently.

My faithful old typewriter decided that it would only print about two lines before it started typing each letter on top of the last. It would do this for a little while, then the whole gizmo would shut down.

Effectively, what had happened was that the carriage feed motor stopped working. I felt that there was nothing wrong with the motor, since it worked well enough next time, after things had cooled down a bit.

At first I didn't feel like poking around in there myself, so I took it back to the shop where I had bought it. They called me back in a couple of weeks and said that they didn't know how to fix it (or words to that effect).

So I took my machine home and began looking around the shops for a replacement. I was half inclined to junk the old machine, but I didn't like what I saw among the new models so I decided to have a look at my old machine, to see what I could do about it.

My first break was the discovery that, when typing properly, the microprocessor was getting an ACK (acknowledge) signal on pin 10, but that this signal was absent when it shut down. Yet by turning the carriage motor by hand, the machine would print properly and the ACK signal reappeared at the microprocessor. My suspicion was that one of the machine's many power supply rails was faulty. But which one? None of my measurements showed anything out of the ordinary, but there had to be something wrong. So I gave the power supplies a more critical look.

The +10V regulated supply tested OK and so did all the components around that area. Just the same, I looked with suspicion at the 2SD718 series pass transistor. It wouldn't be the first time a transistor passed every test but still wouldn't work reliably in circuit.

And that's all it was! The transistor was all but useless under load, once it had warmed up a bit. A quick zap with freezer spray briefly restored normality, proving that the transistor was completely US. So I changed it and the machine is now working perfectly.

I puzzled over why my 'dynamic' tests showed the transistor to be working, when it obviously wasn't. I've decided that the main load comprised very brief pulses of current to the stepper motor and this the transistor was unable to handle. At all other times, the only load was the few microamps to the electronics and the transistor was easily able to handle this.

So my digital multimeter showed the 10V rail to be normal when it was powering only the microprocessor, and was unable to resolve the momentary failure when the stepper motor was trying to draw current!

I've written this story with the same trusty Fordigraph (Towa? TEC?) and you can see, there's not an overprint to be seen.

Thanks, E.T. I agree, your typing was immaculate. And your story was also an interesting comment on a sub-

ject that doesn't often find its way into these pages.

We have often considered 'domestic electronics' to comprise nothing but TV and video recorders. However, your story shows that there are a lot of other common products that come under the general banner of electronics, and as such deserve a place in these columns.

So thanks, E.T. What about a story from your musical repertoire? An occasional tune or two wouldn't go amiss in these pages!

RF remote controls

Our next story is also from a contributor and it, too, is about an electronic product out of the usual TV/VCR product line. It comes from K.W., of Hawthorn in Victoria. It also goes to show that anyone taking on electronics as a profession needs also to take on a very liberal philosophy. As you will see at the end of his second story, K.W. is on the verge of adopting that liberal thingummy...

His story goes like this:

A friend of mine mentioned that only two out of three remote controls for his garage doors were working normally. One of them had to be brought to within two metres of the door before it would work.

I gave it a routine check, for flat batteries, broken tracks etc., but found no clues whatsoever. They were simple units, with just three transistors, an encoder IC, a DIL switch and a ferrite core antenna, all in perfect condition.

I compared the voltages on the transistors with one of the working units and found them to be identical. Then I compared the encoder signals and RF transistor outputs with the CRO, but could find nothing different in either unit.

At this stage, I drew a circuit diagram to try to get an idea of how the thing worked. It turned out that the transistor next to the crystal was the oscillator, as expected. The transistor next to the ferrite rod had to be the RF power amplifier, and it was.

The third 'transistor' turned out to be an SCR which 'keyed' the RF amplifier with the security code from the IC. So far, so good. Same encoder, same HF output — it just did not work like the good ones.

The only thing left was frequency drift, but I don't own a frequency meter, nor do any of my colleagues. Renting one was also out of the question. I simply had to find a simple way to check or compare the frequency of the output signal.

Switching on the brain sometimes helps and when I tried this, my eye caught the scanner receiver on the shelf. So I set the scanner to 40.680MHz (the same as the remote control crystal) and tried the remotes again. The scanner responded with burbling audio tone.

The faulty remote gave only a quarter of the audible output from the scanner compared with either of the good remotes. I tried adjusting the RF output frequency with the trimmer capacitor, but soon realised that the trimmer was faulty.

Fitting a new trimmer allowed me to peak the output right on frequency, and that control now works better than either of the other two!

It's said that problems normally come in groups, so it was no surprise when, on holiday in Brisbane, and attending a grill party with friends, a neighbour learned about my electronic background and — you guessed it — wanted my opinion about his electronic garage door opener.

(Interjection: I wonder if off-duty doctors and lawyers get questioned as often as electronic technicians do. I've even had a doctor spend most of MY consultation time quizzing me about HIS TV! — The Serviceman).

He had to get out of the car to get close enough to the door to allow the remote control to work. The control was one of the very cheap types, with no encoder, no crystal, just the radio signal (presumably wide band).

Since I could find nothing wrong with the transmitter, my next step was to look at the receiver. This was tucked away on the wall, covered with a plywood panel.

To my surprise, the antenna was just five feet of insulated wire, but it was wrapped neatly around a water pipe and taped into place over a distance of about two feet.

While I unwrapped the antenna, I suggested that he go down the street about 100 metres, then press the transmitter button as he walked back towards the garage. (It was easy to read what was in his mind at that point!)

When he reached the distance, he pressed the button and the garage door opened. In absolute disbelief, he tried again and again, and each time the door opened or closed on command.

He came back jumping up and down — "How did you do this?" he demanded. "I've had three specialists in the past two years — at $60 per hour — with all their expensive equipment, and they got nowhere! They just blamed it on a cheap brand, yet you fixed it and didn't even need a screwdriver!"

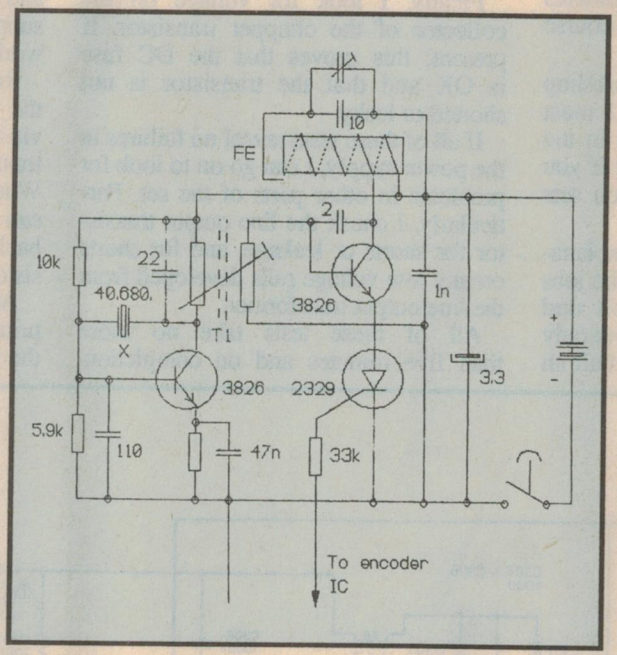
I had to dampen his enthusiasm a bit and told him that it would not be wise to leave it like that. Otherwise any radio signal from taxis, police, CB radios or the like could open his garage door. I wrapped half the antenna back around the pipe and left just enough to give a safe operating distance of about 10 metres.

Back at the grill party, I was the hero of the day. But I'll have to stay away from that area in future — or else open a repair shop!

Thanks, K.W. Those are just the kind of stories that add interest to The Serviceman column each month.

I like to keep a balance between TV/VCR stories and general interest items like K.W.'s, so please — if your story deals with electronics of any kind, send it to the Editor. It could be worth money to you.

Incidentally, K.W.'s story reminds me of a yarn I heard some time ago. It was told in a hotel bar, so I can't vouch for its authenticity; but it would appear that the speaker had not long since had a heart pacemaker fitted — and every time he coughed, his neighbour's garage door opened...



Contributor K.W., of Hawthorn in Victoria was asked to find why a friend's garage door opener wasn't working properly. It turned out to be a component fault in the remote control unit, shown here.

THE SERVICEMAN

All right! All right! No more funnies this month. Back to serious matters.

Students' sets

I had two small jobs land on my own bench recently. They were both television power supply problems and in other circumstances, they would never have rated a mention in this column. The thing that was unusual about these jobs was that each of them was brought in by one of the students from a TAFE college televsion course that I taught last year.

When they turned up at my workshop and asked me to fix their sets, I must admit I got a bit stroppy. "Why in the 'ell did I waste my time last year if you now can't fix your own television sets now?", I raved.

They each offered reasonable explanations as to why they couldn't do the jobs themselves, so I softened a bit and agreed to do the work for them. But only on condition that they each spent half an hour with me, trying to nut out the problem for themselves.

The first set was a Sanyo CTP3621, a 34cm model fitted with an 80P chassis.

The set appeared to be totally inoperative, so my first test was for AC at the bridge rectifier. This tests the integrity of the power plug, power cord, power switch and the AC fuse.

If I find AC on the bridge, I next test for voltage across the main filter capacitor. This confirms that there are no shorted diodes in the bridge, and that the filter capacitor itself is not shorted.

Finally, I look for voltage on the collector of the chopper transistor. If present, this proves that the DC fuse is OK and that the transistor is not shorted or leaky.

If all of these tests reveal no failures in the power supply, I can go on to look for problems in other parts of the set. Particularly, I check the line output transistor for shorts or leakage, and for shorts on any low voltage rails developed from the line output transformer.

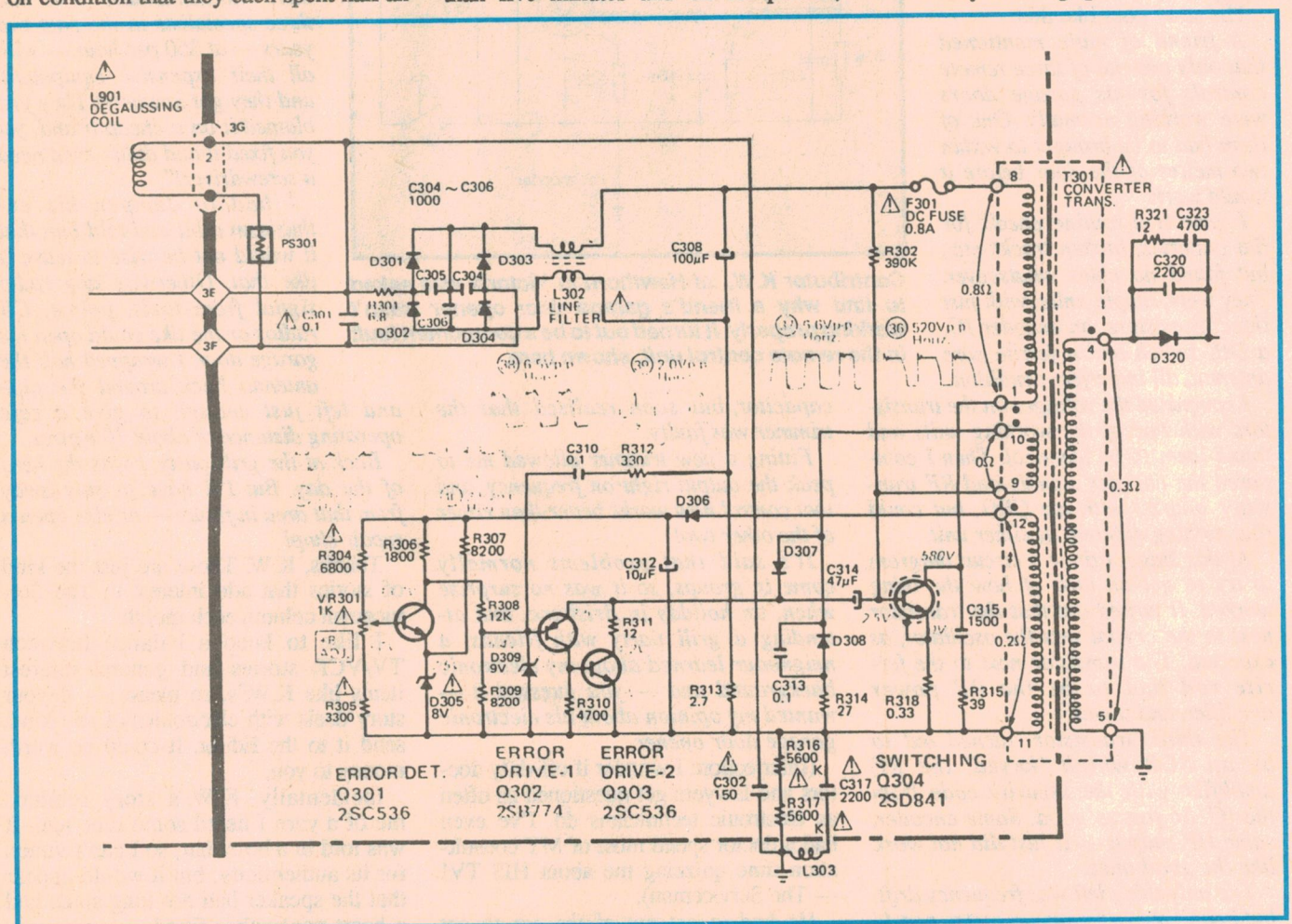
All of these tests take no more than five minutes and on completion, I should have a pretty good idea of what is wrong and some indication of where the problem lies.

The set in question showed a high voltage on the chopper collector, around 300 volts! What's more, it was still there 10 minutes later, when I accidentally shorted the terminals on the main filter cap. The 'ZAP!' as the cap discharged startled me and scared the shirt off my student friend...

At this point I made him sit down with the circuit diagram and try to work out how the system was supposed to work, and why it wasn't doing what it was supposed to do. Basically, the system works like this:

Roughly filtered DC is supplied to the collector of the chopper transistor via the primary winding of the chopper transformer, between pins 8 and 1. When the transistor is turned on, current can flow through the transformer and back to the bridge via the chopper transistor (and R313).

As current starts to flow through the primary winding, a voltage is induced in the tertiary winding (pins 9 - 10), which



The first of two sets brought to our Serviceman this month by one of his former students was a Sanyo CTP3621, which was totally inoperative. As you might suspect, the fault lay in the power supply — the schematic for which is shown here.

provides positive feedback to the transistor base. This ensures that the transistor turns on very quickly and reaches saturation before excessive dissipation can cause damage to the device.

Eventually, current through the transformer winding reaches a maximum value and stabilises at that point. Since the magnetic flux then stops increasing, the positive feedback to the base of the transistor ceases and the transistor comes out of saturation. As the collector current falls, the feedback process is reversed to ensure that the transistor now switches off rapidly.

The whole process then repeats and we have a 'self oscillating switch mode power supply'. Except that in the case of the Sanyo CTV, we didn't have a self oscillating switch mode power supply. We had all the necessary components, along with a suitable supply voltage. But the thing *wasn't* oscillating...

This was the problem I put to my student friend. Why was there no activity?

There was obviously a faulty part somewhere, but what could it be?I left him alone with the circuit diagram for half an hour while I got on with other business, and at about the 28th minute he asked "...what if R302 was open circuit?"

"Well," I said, "you tell me what *you* think!"

He went on the explain that connecting the base of an NPN transistor to the positive supply rail normally turns the device on and R302 seemed to do exactly that. If that resistor was open circuit, there is no other way the transistor could get a 'startup' bias.

I awarded him 10 out of 10 for that one, and suggested that he remove the resistor and check its value. It should be 390k ohms, but this one was in excess of 20 megohms.

A new resistor put the set back into full working order and my student friend was elated. He asked "How much?", but I declined to charge him for the job. I reckoned that I had got enough from his student fees last year and just maybe I'd missed a point that would have helped him solve this problem on his own.

It just goes to show that knowing HOW things work is a necessary adjunct to finding out WHY they work — or in this case, *don't* work.

Another dud supply

The second set in this couplet of problems was a 48cm JVC set, a model 7485AU. It belonged to a friend of the (former) student, who brought it in. He had been trying for some time to solve the problem, but was in that sorry position where he couldn't really define what was wrong with it. In fact, the set was behaving rather strangely and even I had a bit of trouble defining the symptoms.

When first turned on, both sound and EHT would come up normally. However, just as one would expect the picture to appear, the raster collapsed to a vertical line, the sound stopped, and the set reverted to the off state. When the power was then turned OFF, both sound and raster reappeared momentarily, as the set returned to the true off state.

If the power switch was turned on and off quickly, the tube heater could be kept warm enough to allow the set to display a partial picture.

After my friend had demonstrated the symptoms, I conceded that he really had no hope of solving the problem, given his relatively limited experience. I myself had to spend some time with the circuit diagram to determine exactly what was going on, and even now I'm not sure how the fault caused the symptoms!

I removed the cabinet back and with the power turned on, measured the voltage on the emitter of the power regulator transistor. It was a steady 150V DC! It should have been only 110V and in other circumstances, one would expect the higher voltage to produce smoke and fireworks. What was happening here was that a protection circuit of some kind was killing the line oscillator, so preventing further damage.

I've struck this fault in other sets that use a series regulator power supply. It has invariably been caused by a shorted regulator transistor. In most cases a fuse blows to prevent damage to the set. This time there was a very effective protection circuit doing the same job.

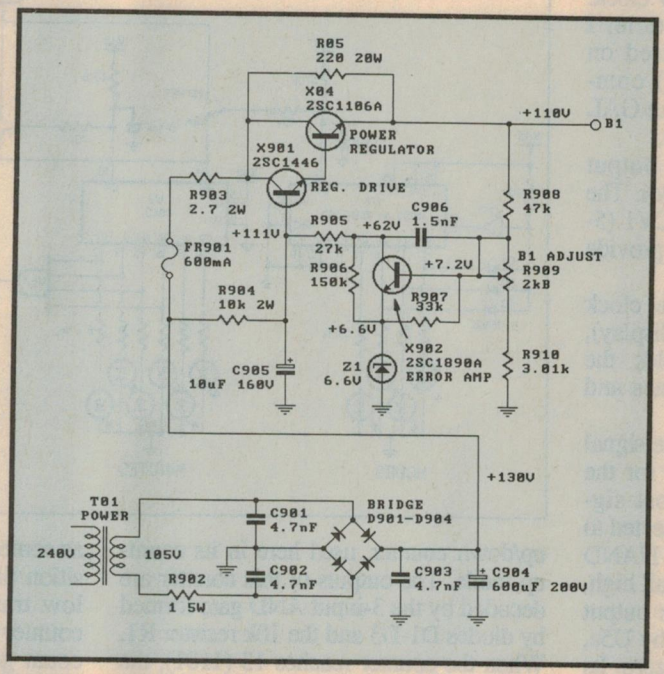
So my first test was to check the regulator transistor for shorts or leakage. But I might have known it wasn't going to be so easy; my student friend said that he had already checked that transistor, and a few others as well. None of those he could get at were faulty in any way, and I quickly confirmed that he had done an accurate job. One final test, before we got down to the nitty-gritty of solving the problem, was to connect the set to the mains via a variac. This allowed me to adjust the regulator output to the required 110V and confirm that the set now operated properly. It took about 160 volts AC input to get the right DC output, but the set then showed perfect sound and picture — enough to convince us that the only fault was in the power supply. At this point I made him sit down with the diagram and study the circuit operation. We knew that the supply was outputting a high voltage, yet the regulator transistor was not shorted. "What", I asked him, "could produce the effect of a shorted transistor without actually shorting the device?"

He thought for a moment, then suggested that perhaps the transistor was turned hard on. In other words, saturated. This would look like a shorted device while ever the supply was active, but would display no such symptoms with the power off.

I agreed with that hypothesis and pointed out that we now knew what was happening, but not *why*. Finding the answer to that question would take still more puzzling over the circuit diagram.

This is a very simple regulator circuit. The conduction in the main transistor X04 is determined by the collector current in the driver transistor X901. This is set to some maximum value by the resis-

Continued on page 66



The second faulty set was a JVC model 7485AU, which also turned out to have a fault in the power supply. A simplified version of the schematic is shown here.

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Binary clock

I recently saw an article in a rival publication on how to build a binary clock. However, after reading the article, I decided to design my own, based on readily available (and cheap) components, avoiding the need for three GAL devices and a kit costing over $75.

Counter U3 provides a 2Hz output from a 32.768kHz crystal oscillator. The crystal frequency is trimmed by CV1 (5-30pF) and C1 (39pF), which also provide the correct load for the crystal.

The 2Hz signal is fed to the clock input of counter U4 (seconds display), via a SPST switch which holds the counting when setting the minutes and hour counters.

The first stage of U4 divides the signal by two, providing a 1Hz signal for the following stages. The four most significant outputs (Q3-Q6) are connected to the inputs of U6b, a dual 4-input NAND gate. When the inputs to U6b are all high, corresponding to decimal 60, its output goes low. This signal is inverted by U5c, which resets the counter back to zero. Its count sequence then repeats.

The output of U6b also connects to the clock input of the minutes counter, U2. This IC is connected the same as the seconds counter U4, except that the first output (Q0) is used to drive a LED. This means outputs Q2-Q5 are decoded by U6a to give the reset signal to the counter at a count of 60.

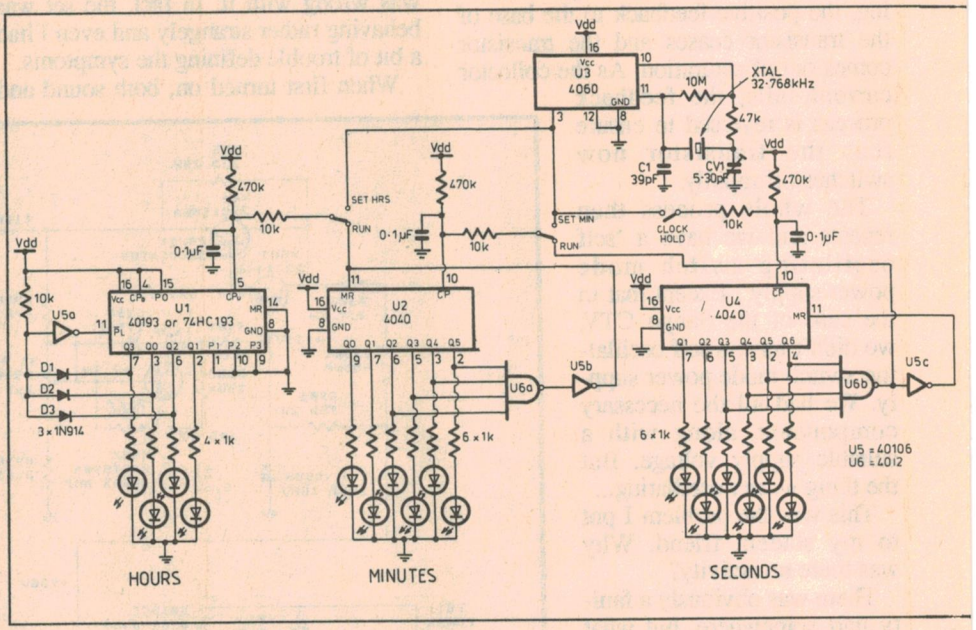
The output of inverter U5b clocks the hours counter U1, a presettable 4-bit up/down counter, used here in its count-up mode. The outputs of this counter are decoded by the 3-input AND gate formed by diodes D1-D3 and the 10k resistor R1. When the counter reaches 13 (1101), the output of the AND gate goes high. This signal is inverted by U5a, causing the data at the parallel load inputs (P0-P3) to be loaded into the counter. The inputs are set to 0001, which means the LED display changes from 1100 (12) to 0001 (1).

The RC networks at the clock inputs debounce the switches. These networks should not be used with a 74193 TTL IC. Also, you may need to include a 0.1uF capacitor from the load input to ground, as some devices have a low to high transition time that is faster than the high to low transition, which many cause the counter to falsely load itself before the count gets to 13. This is not a problem with the asynchronous 4040 counters.

Other counters may be used, such as the 74LS191, 74LS161, '163, or the CMOS versions of these devices. They all have different pinouts, but the idea is the same.

The total cost of the clock is under $20, and can be powered from a plugpack, via a filter/regulator.

L. Turner,
Gawler, SA. **$45**

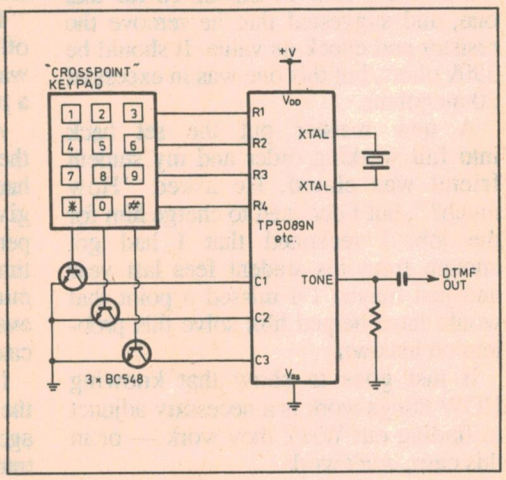


DTMF keypad interface

A problem frequently encountered when trying to connect a 'telephone' style keypad to a dual-tone multiple-frequency (DTMF) generator IC such as the TP5089N is that many of these ICs want to see one 'row' and one 'column' input simultaneously grounded to produce an output signal. Unfortunately, many of the available keypads, eg, Jaycar SP-0770, are arranged as a simple crosspoint matrix which only connects the selected row and column together, with no common ground.

This problem can be easily overcome with three low-power NPN transistors connected as shown. Say key 5 is pressed. Row 2 (R2) is effectively earthed by the base of Q2, while the collector of Q2 provides the required earth to column 2 (C2), since Q2 is forward-biased by the base current (about 100uA) from the internal pull-up resistor for R2. The same principle applies to all other input combinations. Of course, a fourth transistor can be connected in the same way if the auxiliary A, B, C and D tone pairs and a 16-key pad are needed.

Bob Parker,
Carlton, NSW. **$35**



Electronic fuse

This electronic fuse will disconnect a DC load if the load current exceeds a preset value. To reset the circuit, simply switch off the power for a short time, then restore power. The circuit has two connections, labelled A and B, and can be connected on either side of the load.

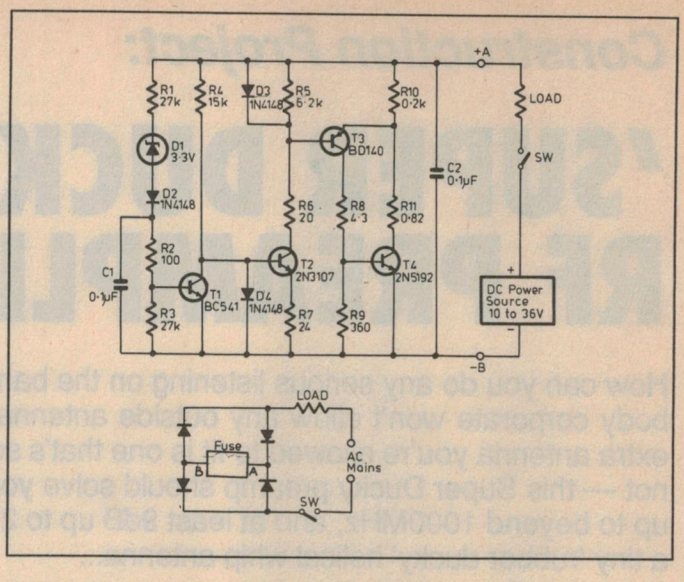
The load current flows through transistor T4 and resistors R10 and R11. The voltage across terminals A-B is proportional to the load current, and most of the voltage drop is across the resistors.

When power is first applied, the full supply voltage appears across the fuse. Transistor T2 is switched on by the current in R4, and the value of its collector current is determined by the equation VD4 = VR7 + 0.6.

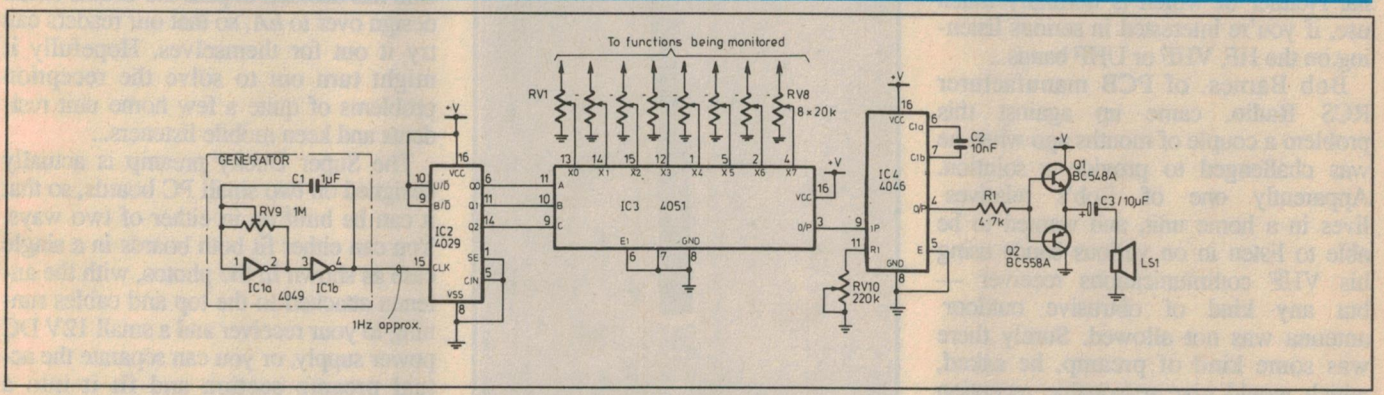
Because the voltage across D4 (VD4) is constant, the voltage across R7 (VR7) and therefore the collector current of T2 is constant. This transistor supplies stabilised base current to T3, which therefore switches on, in turn supplying stabilised base current to T4. The fuse conducts and load current flows. When power is first applied, capacitor C1 provides a time delay to prevent T1 conducting and holding T2 off.

The voltage across the fuse (VAB) is normally less than 2V, depending on the load current. When the load current rises, this voltage increases and a point is reached when diode D4 conducts sufficiently to take some of the base current of T2. The collector current of T2 is therefore limited, as is the current in T3 and T4. Because of this, the voltage across the fuse increases further, until at around 4.5V, zener diode D1 conducts, turning on T1. When T1 switches on, it takes the base current of T2, turning T2 off. This causes T3 and T4 to also turn off, and the voltage across the fuse increases, causing regenerative feedback to make these transistors switch off even more.

The purpose of C1 is to give a time delay so the fuse can handle short-duration overloads, such as the switch-on current of an incandescent lamp or the start-up current of a DC motor. The time delay can therefore be changed by changing the value of C1. The voltage range of the circuit is from 10V to 36V DC and the time delay is about 0.1 seconds. For the values shown in the circuit, the load current is limited to 1A. The load current can be anywhere from 10mA to 40A by changing the component values. With suitably rated components, the operating voltage of the circuit can be 6V to 500V. The fuse can also be used in an AC circuit by using a rectifier bridge as shown in (b) below the main circuit. Capacitor C2 provides protection against transients across the fuse terminals. Diode D2 prevents C1 from discharging through the load when the voltage across the fuse is very low.



N. Lavrentiev,
Kaliningrad, Russia. **$55**



Sound indicator for the sight-impaired

It's sometimes difficult for those with failing sight to know if they have operated the correct pushbutton or switch on an alarm system, a timer, a keyboard or similar. This circuit helps overcome the problem by producing a different sound for up to eight independent logic signals, helping the operator know which signal is on. It operates on the basis that, when operated, each switch or pushbutton on the device being monitored produces a logic 1, perhaps to operate an indicator LED. The circuit is cheap to build, has a low power consumption and can operate with a wide range of supply voltages. It could therefore be integrated with the equipment being monitored.

The logic signals from the equipment being monitored are connected to the X0 to X7 inputs of IC3, through potentiometers RV1 to RV8. The pots are adjusted so they each give a different voltage at their wiper and hence to the inputs of IC3. IC1a and IC1b form a low frequency oscillator (about 1Hz). Its pulse sequence is counted by counter IC2, and the outputs of IC2 operate the 1-of-8 analog multiplexer IC3.

The output of the multiplexer is connected to the input of IC4, a voltage controlled oscillator. The VCO drives a loudspeaker via Q1 and Q2. The midpoint operating frequency of the VCO is set by the values of C2 and RV10. Adjust this frequency when the input to pin 9 (of IC4) is about half the supply voltage.

When a switch on the device being monitored is operated, producing a logic 1, it will produce a voltage determined by the setting of the particular potentiometer (VR1 to VR8). This voltage will be applied via the analog multiplexer IC3 to the input of the VCO when the counter has cycled IC3 to that input. The sound for that input will be heard, indicating that it's on.

V.B. Oleinik,
Kaliningrad, Russia. **$50**

Construction Project:

'SUPER DUCKY' RF PREAMPLIFIER

How can you do any serious listening on the bands, when you're living in a block of units where the body corporate won't allow any outside antennas? Or use your scanner in the car, when the only extra antenna you're allowed to fit is one that's so small it'll only bring in the strongest signals? Fear not — this Super Ducky preamp should solve your problems. It typically provides over 20dB of gain up to beyond 1000MHz, and at least 9dB up to 2GHz — producing quite amazing results even from a tiny 'rubber ducky' helical whip antenna...

by JIM ROWE

Nowadays a lot of people live in home units, where quite apart from any practical problems, there are often regulations concerning your ability to fit things like outside antennas. There's also a practical limitation on the kind and size of antenna you can fit to a vehicle, for mobile operation.

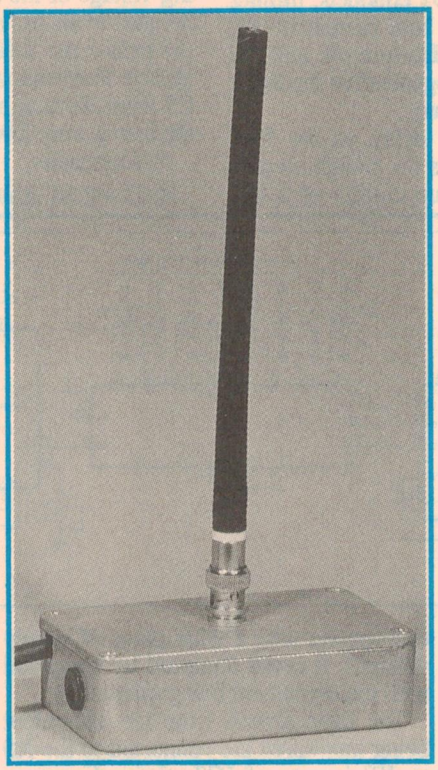
In other words, a lot of people are stuck with either an indoor antenna, or at best a very small and unobtrusive outside antenna. Neither of which is normally much use, if you're interested in serious listening on the HF, VHF or UHF bands...

Bob Barnes, of PCB manufacturer RCS Radio, came up against this problem a couple of months ago when he was challenged to provide a solution. Apparently one of Bob's relatives lives in a home unit, and wanted to be able to listen in on various bands using his VHF communications receiver — but any kind of obtrusive outdoor antenna was not allowed. Surely there was some kind of preamp, he asked, which would give reasonable reception with a small whip, or perhaps even a 'rubber ducky' antenna?

Bob wasn't sure how successful it would be, but he decided to have a go at producing such a preamp.

He elected to try producing a wideband preamp, to avoid the need for additional tuning, and to use one of the miniature RF amplifier ICs made for this kind of application. After hearing of the results achieved by some of his radio amateur friends using the low-cost 'MAR' family of RF amplifier chips, made by US firm Mini-Circuits, he decided to try one of these — the MAR-6, which comes in a tiny 'pill' package 2mm in diameter by 1.5mm thick, with four radial leads.

The results from the first rough preamp Bob built using the MAR-6 were very impressive. Even with a rubber ducky antenna only 180mm long, he was able to bring in all kinds of surprising signals on various VHF and UHF bands — signals that in some cases were either inaudible, or barely audible using a much larger external antenna such as a discone.



Spurred on by this result, he was encouraged to tidy up his PCB designs and produce a 'pretty' version, so that others could build it up. And that's the story behind this 'Super Ducky' preamp design.

Bob himself has built up a few units from the new design, one of which was given to the relative who triggered off the whole exercise (and who is delighted at the result, needless to say). Others have been tried out by some of Bob's friends, many of whom have been amazed at the quality of reception it makes possible using such a small and rudimentary antenna.

Encouraged by the glowing reports, Bob has decided to pass the details of his design over to *EA*, so that our readers can try it out for themselves. Hopefully it might turn out to solve the reception problems of quite a few home unit residents and keen mobile listeners...

The Super Ducky preamp is actually designed on two small PC boards, so that it can be built up in either of two ways. You can either fit both boards in a single case as shown in the photos, with the antenna attached to the top and cables running to your receiver and a small 12V DC power supply, or you can separate the actual preamp section and fit it into a smaller 'masthead' box, perhaps mounted out on a balcony railing with the antenna.

It's a flexible design, in other words, and can easily be adapted for either indoor or outdoor mounting. Since it operates from 12V DC it's also equally suited for fixed or mobile use.

By the way, as printed circuit boards are Bob's livelihood, he is retaining the commercial copyright to the PCB patterns. All this means is that if you want to buy a pair of ready-made boards for the preamp, you'll only be able to buy them from RCS Radio. But Bob has allowed us to reproduce the patterns here, so that private individuals who prefer to etch their own boards can still do so.

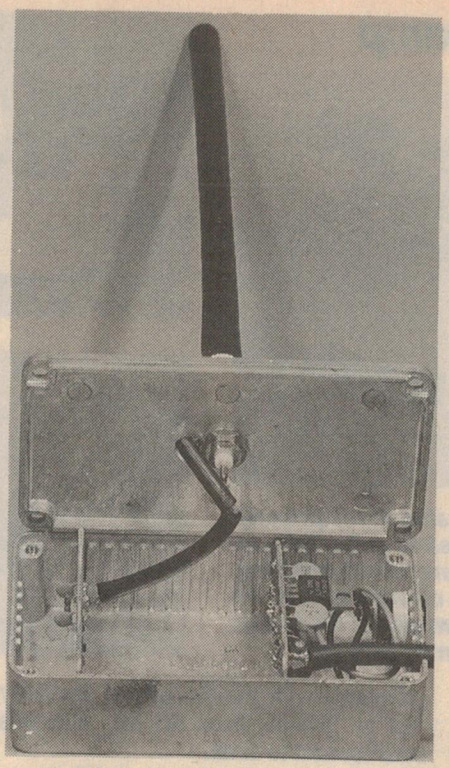
Perhaps we should also note here that the MAR-6 amplifier device which forms the heart of the preamp is not available from a wide range of suppliers, but is certainly available quite readily from Oatley Electronics in Sydney, or Daycom/Stewart Electronic Components in Melbourne.

Circuit description

As you can see from the schematic, the circuit is divided logically into two sections: the preamp proper, and a power regulation and loading section. Each of these two sections is mounted on a separate small PCB, and as there's only a single coaxial cable between the two, this allows them to be easily separated.

Thanks to the MAR-6 chip, the actual preamp involves only four other parts. Capacitors C5 and C6 are used to couple the signals from the BNC antenna input socket to the MAR-6 input pin, while blocking any static charge that may build up. Diodes D4 and D5 are to clip any very large signal which may be induced in the antenna, again preventing damage to the MAR-6. A second function of C6 is to prevent the diodes from disturbing the quiescent bias at the amplifier chip's input.

As the MAR-6 chip is designed to be 'phantom powered' via its RF output pin, both pins 2 and 4 are grounded to provide additional shielding between input and output. This together with careful PCB design ensures that the preamp is stable and provides smooth, quiet amplification over a very wide band of frequencies.



Inside the box, the circuitry is on two small PC boards which mount neatly in the internal slots.

The output pin of the MAR-6 forms the preamp section output, and this is coupled via coax to the second PCB. Here the RF output signals are coupled out to the receiver, via blocking capacitor C4, while the MAR-6 is supplied with its DC power via the 15uH shunt inductor L1, in series with a ferrite bead to again ensure stable operation.

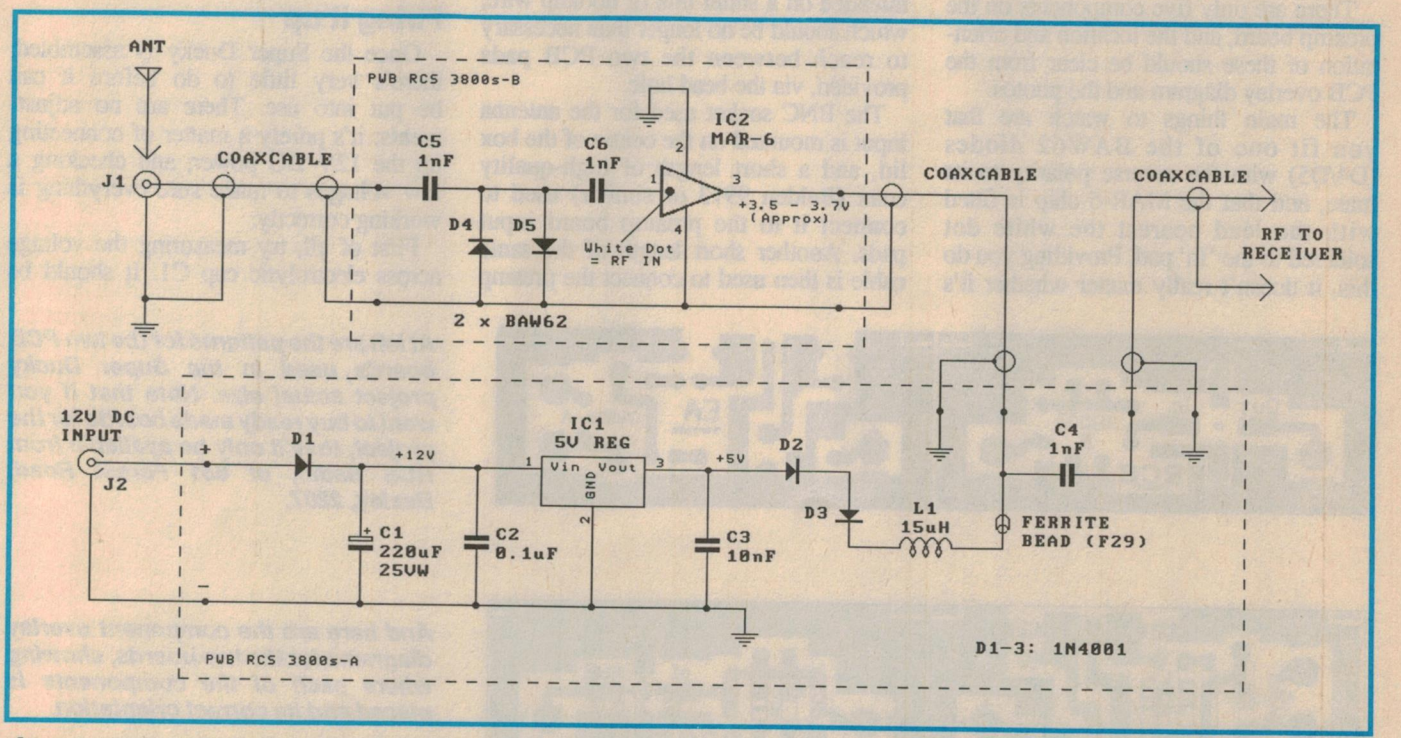
As the MAR-6 requires a stable and regulated supply voltage of around 3.5V, the rest of the circuit is designed to derive such a voltage from an unregulated 12V DC input (e.g., from either a plug-pack supply or a car battery). Most of the regulation is performed by IC1, a standard 5V three-terminal regulator, with input series diode D1 provided to prevent damage due to reversed supply polarity, and capacitors C1, C2 and C3 to remove any ripple and ensure that the regulator operates stably.

Series diodes D2 and D3 are then used to drop the +5V regulator output by a further 1.3V or so, to the level needed by the MAR-6.

The total drain from the 12V supply is very small, a few tens of milliamps, so that the preamp can easily be powered from a 250mA or smaller plug pack if desired.

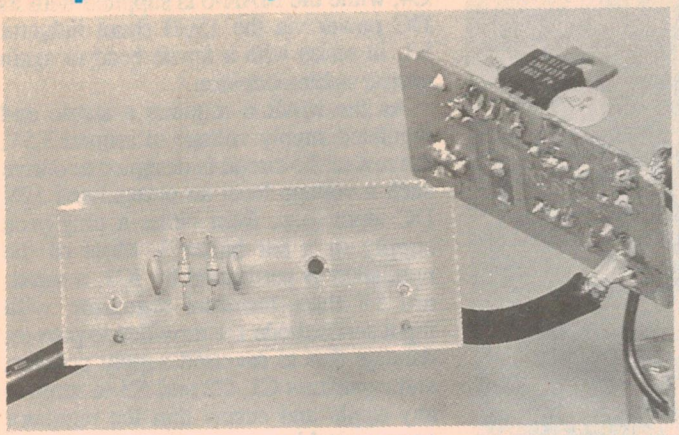
Construction

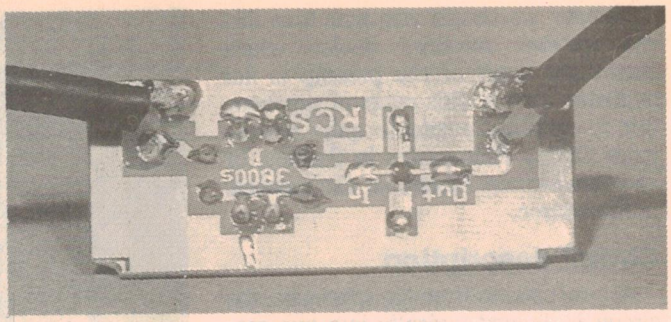
As noted earlier, the circuitry of the Super Ducky preamp is all fitted on two small PC boards, each measuring 57 x 24mm and coded 94rfp9a and 94rfp9b (RCS 3800s A/B). Bob Barnes has designed the boards to fit neatly in the slots of a standard diecast aluminium box, measuring 110 x 62 x 31mm. (Dick

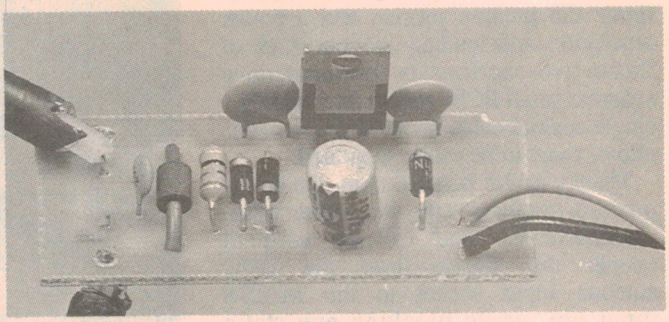


As you can see from the schematic, the preamp uses very few components. The most important part is IC2, an MAR-6 wideband RF amplifier device which provides over 20dB of gain to beyond 1GHz.

'Super Ducky' RF Preamp







Above is a close up of the component side of the preamp board, with the regulator board also visible at its right. At upper right is the copper side of the preamp board, showing the MAR-6 device positioned over the clearance hole. At lower right is a close up of the component side of the power regulator board; note the ferrite bead on its wire link.

Smith Electronics stocks this box as Cat. No. H-2202, for example.)

Note that both boards need to have small shallow notches cut from their two 'upper' corners, to clear the fillet around the inside of the box lid. The notches are indicated in the PCB patterns, and can be seen in the photos. The preamp board itself also needs to have a 3mm hole drilled in the centre of the four pads for IC2, to accept the body of the MAR-6 device and allow its pins to lie flat on the PCB tracks before soldering.

There are only five components on the preamp board, and the location and orientation of these should be clear from the PCB overlay diagram and the photos.

The main things to watch are that you fit one of the BAW62 diodes (D4/D5) with the reverse polarity to its mate, and that the MAR-6 chip is fitted with the lead nearest the white dot soldered to the 'In' pad. Providing you do this, it doesn't really matter whether it's orientated with the dot side of the body 'up' or 'down', since the two side pins both connect to earth.

On the power regulator board there are again only a handful of components, and as before their location and orientation should be clear from the overlay diagram and photos. The main things to watch here are that the diodes and electrolytic capacitor are orientated correctly, and that the 7805 regulator is mounted with its metal tab side away from the adjacent board edge. Note that the ferrite bead is threaded on a small link of hookup wire, which should be no longer than necessary to reach between the two PCB pads provided, via the bead hole.

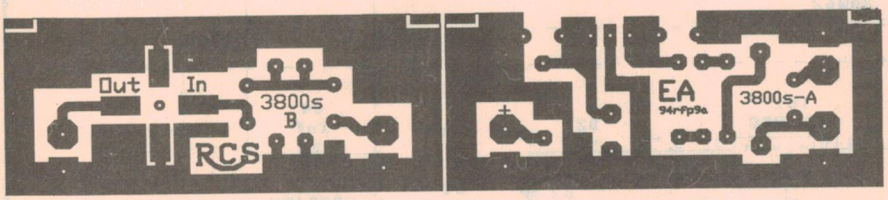
The BNC socket used for the antenna input is mounted on the centre of the box lid, and a short length of high-quality coax (Belden 9913 or similar) used to connect it to the preamp board input pads. Another short length of the same cable is then used to connect the preamp board to the regulator board, and a suitable longer length used for the cable connecting the output of the regulator board to the receiver.

The 12V DC input to the Super Ducky is made via a small concentric power connector, fitted to one end of the box and of whatever size is needed to mate with the plug on your plug pack supply, etc. Inside the box the connections from the socket to the regulator board are made via two short lengths of insulated hookup wire.

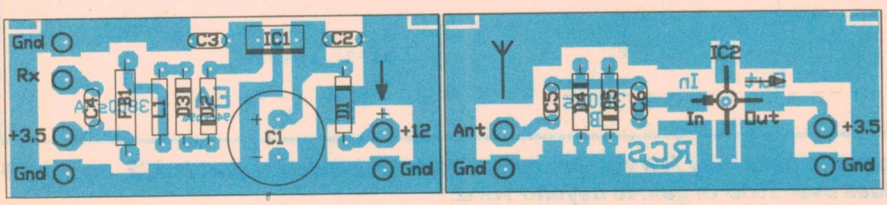
Firing it up

Once the Super Ducky is assembled, there's very little to do before it can be put into use. There are no adjustments; it's purely a matter of connecting up the 12V DC power, and checking a few voltages to make sure everything is working correctly.

First of all, try measuring the voltage across electrolytic cap C1. It should be



At left are the patterns for the two PCB boards used in the Super Ducky project actual size. Note that if you want to buy ready made boards for the project, they'll only be available from RCS Radio, of 651 Forest Road, Bexley, 2207.



And here are the component overlay diagrams for the two boards, showing where each of the components is placed and its correct orientation.

PARTS LIST

Semiconductors

D1-3 1N4001, 1N4004 or similar
D4-5 BAW62 high speed diode
IC1 7805 5V regulator (TO-220)
IC2 MAR-6 wideband RF amplifier

Capacitors

C1 220uF 25VW electrolytic
C2 0.1uF disc ceramic
C3 10nF disc ceramic
C4-6 1nF disc ceramic

Miscellaneous

L1 15uH RF choke
J1 BNC socket, panel mounting
J2 Coaxial DC input socket
Cast aluminium box, 110 x 62 x 31mm; PC boards, two, each 57 x 24mm and coded 94rfp9a/b (3800s-A/B); F29 ferrite bead; short lengths of hookup wire; short lengths of high quality 50- ohm coaxial cable; solder, etc.

about 12V, of course; if it's zero, you have either the plug-pack supply connected up with the reverse polarity, or D1 is fitted to the board with reversed polarity. If the voltage across C1 seems OK, try measuring the voltage across C3. This should be 5V, of course. If it isn't, you may have regulator IC1 connected in the wrong way around.

Finally, try measuring the voltage at the output pin (3) of the MAR-6 chip, relative to ground. It should be around +3.5V; if it's zero, you most probably have one of the diodes D2 or D3 fitted around the wrong way.

If all three of these voltages are correct, you should be able to remove the power, slide the two boards into the box and screw the lid on. Your Super Ducky preamp should now be complete, and ready to hook up to your receiver and a suitable antenna.

Try using it with a 'rubber ducky' antenna, such as the little 2m model sold by DSE stores as Cat. No. D-4330. You'll be very pleasantly surprised!

A final comment. As with any untuned RF preamp, the Super Ducky is likely to produce intermodulation problems if there are some very strong signals in the immediate vicinity. The only real solution to this kind of problem is to 'notch out' the offending signals with a filter, fitted between the antenna and the preamp input. The filter can be of the tuned stub, tuned cavity or lumped-constant (L and C) type; it generally doesn't matter, as long as it produces a suitable level of attenuation.

I understand that Bob Barnes is looking into this, and if he comes up with a suitable filter design to work nicely with the Super Ducky, we'll be happy to publish the details. ❖

NOTES AND ERRATA

Light and Sound Trigger (April 1994): The overlay diagrams for this project were reversed during printing. They are now reproduced below, the right way round for those readers interested in this project.

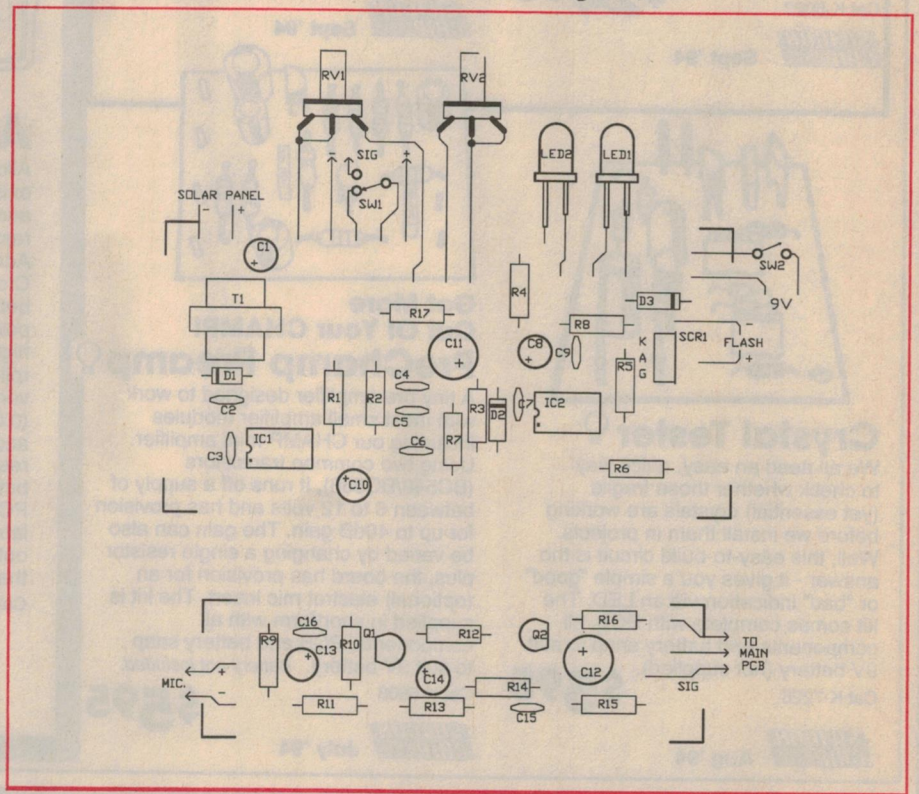
DSO Adaptor Mk 2 (May - July 1994): The insulated wire link from pin 15 of header connector J2 should connect to the Q-bar output of sampling control flipflop U9b, not the Q output as shown in the schematic of page 59 of the May article. In fact the most convenient point to connect the link is to pin 13 of A/D converter chip U12, which connects to U9b via the PCB tracks; this gives the shortest link length.

Note that incorrect connection data for this link is also given in the June article, in the text on page 69 (third column, just before the cross heading), and in the last sentence of the PCB overlay diagram caption on page 73. In both cases the link should be described as connecting to pin 13 of U12.

Noise and Distortion Meter (May - June 1994): A number of kit resellers are offering this project with a silk-screened front panel, rather than simply including a Dynamark dress panel as used in our prototype unit. While this gives the instrument a neat and professional finish, the screened plastic panel does not offer the shielding properties of the aluminium Dynamark panel, and the front panel controls may become susceptible to interference from mains hum. To compensate, fit a section of shielding material behind the front panel, then earth this to the unit's main OV line (GND) via a short length of hookup wire. This additional shield can be formed with thin tinplate, aluminium or foil or a similar conductive material, and should cover most of the front panel area. Also check that the pot housings are then earthed, but the 'INPUT' socket is isolated as before.

It's also been brought to our attention that some kits have been supplied with the 'grain of wheat' style of lamp for LP1 in the oscillator stage, rather than the specified 'car warning light replacement' type. While the two type of lamps have the same nominal ratings (12V/50mA), the incorrect type will cause the oscillator's distortion to rise by a factor of around five — from about 0.001% THD to 0.005% THD. The correct lamps cost slightly more, and have a white plastic base rather than 'flying' leads.

By the way, this also applies to the 'Sine/squaresave Oscillator' from the May 1992 issue, as this uses an almost identical oscillator circuit and the same stabilising lamp. ❖



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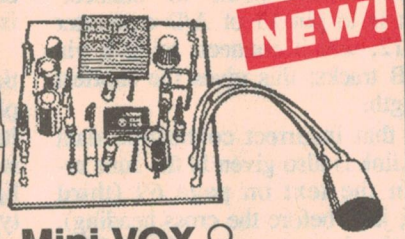
$24.95

Cat K-5022

SILICON CHIP Sept '94

NEW!



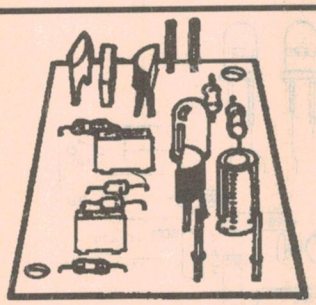
Mini VOX

Build your own tiny voice-activated relay! Great for amateur radio or where hands-free operation is required, it has a very short turn-on delay and will save you the hassle of pushing buttons every time you want to talk. Using just a single IC and an SPDT 12VDC relay, it's designed to fit in the tightest space and runs off just about any 12V DC supply. Supplied in shortform with PCB and components only.

$12.95

Cat K-3038

SILICON CHIP Sept '94



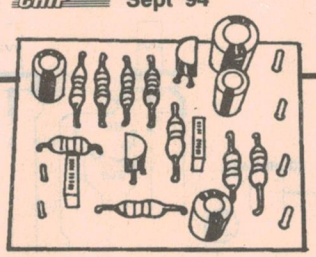
Crystal Tester

We all need an easy, quick way to check whether those fragile (yet essential) crystals are working before we install them in projects. Well, this easy-to-build circuit is the answer - it gives you a simple "good" or "bad" indication via an LED. The kit comes complete with PCB, all components and battery snap to suit 9V battery (not supplied).

$5.95

Cat K-7228

SILICON CHIP Aug '94



Get More Out Of Your CHAMP!

PreChamp Preamp

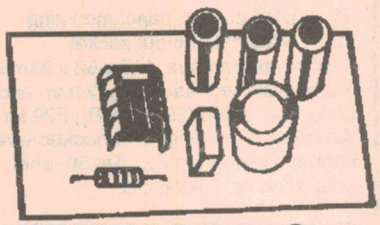
A tiny pre-amplifier designed to work with most small amplifier modules including our CHAMP mini amplifier. Using two common transistors (BC548/BC558), it runs off a supply of between 6 to 12 volts and has provision for up to 40dB gain. The gain can also be varied by changing a single resistor plus, the board has provision for an (optional) electret mic insert. The kit is supplied in shortform with all components, PCB and battery snap to suit 9V battery. *Battery not included.*

$5.95

Cat K-5608

SILICON CHIP July '94

A Big Noise From a Tiny Amp!



The Champ Mini Amp

You'll find this extremely tiny and inexpensive amplifier very handy for audio projects. Especially useful in projects where space is precious (it's even smaller than a 9V battery!), this single channel amplifier pumps 0.5W into 8 ohms with a 9V battery and with internal gain from 20 to 200dB. Comes with components and PCB only.

$5.95

Cat K-5604

SILICON CHIP Feb '94

NEW!

Active Crossover

Allows you to integrate a subwoofer with an existing speaker system for the best possible audio performance. Designed to overcome restrictions found in the popular Sub-woofer Adaptor (Electronics Australia May '89), the Crossover connects in the signal path between the main amplifier's preamp and poweramp stages, offers both low-pass and high-pass outputs which have matching roll-off and phase characteristics, and has very low levels of noise and distortion (0.003% THD at 2V RMS output) . With input and output impedances of 47k and 100ohms respectively and a signal to noise ratio of better that 95dB. Supplied in shortform with PCB and components only. Case, front panel label, and all hardware bits are left as optional so you can incorporate the unit into the equipment of your choice.

$29.95

Cat K-5404

EA Sept '94

We Make Your Job Easier!

BNC 2-Piece Plug

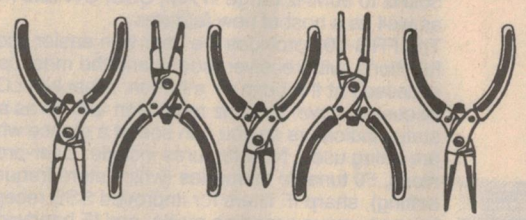
With no soldering required, this plug is easily connected to cable with a crimping tool. Ideal for use with LAN systems, communications equipment or instrument leads. Professional crimping tool (T-3537) recommended

Cat P-2211

$3

NEW!

Micro-Precision Plier Set



A set of spring-loaded micro pliers/nippers with fully-insulated handles. They're made from quality stainless-steel and come with: 90mm cutting nippers, 100mm flat nose, 100mm round nose, 100mm bent nose and 100mm long nose pliers.

Cat T-3575

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Bonus Side Cutters!

5-Piece Soldering Kit

Rated at 25W 240V, this general-purpose Scope iron comes complete with resin-core solder, iron stand, cleaning sponge, and two screwdrivers.

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***Bonus**

SIDE CUTTERS (T-3291) VALUED AT $9.95

Bonus Tip & Element Pack!

100-Watt Soldering Iron

Heats up in a fast six seconds! With manual temperature control, auto-off function and long-life stainless-steel barrel. (Requires T-1692 Transformer).

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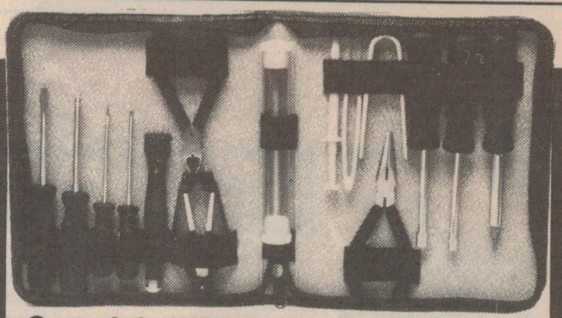
***Bonus**

TIP & ELEMENT PACK (T-1601) VALUED AT $10.95



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16-Piece computer Servicing Kit

A must for all computer enthusiasts. It contains:

- PLCC Extractor
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- Long-Nose Pliers
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- 1/4" Hex Driver
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- Driver Handle
- Double-ended Torx bit
- (T-10/T-15)
- IC Insertor (14 & 16 pin)
- Large Flat-Head Screwdriver - 75 x 5mm
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- IC Extractor

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16th Edition

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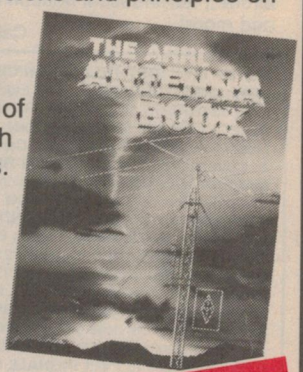
Cat B-2209



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2-year warranty.

Cat D-2755 **$469**

FRG-100 Communications Receiver

YAESU

2 Year Warranty

A highly sensitive professional receiver for the discerning shortwave listener. This model provides extended receiver coverage of the 50kHz to 30MHz range in AM, SSB, CW and FM (optional) modes, as well as a host of new features.

The FRG-100 provides the user with easier access to most receiver functions, with receiver modes and the most-used features instantly accessed at the push of a button. A back-lit LCD screen shows the frequency down to 10Hz resolution as well as an impressive array of status indicators so you can see at a glance what receiver functions are being used. New features include: User-programmable tuning steps, 50 tunable memories (which store frequency, mode and filter setting), sharp IF filters for improved SSB reception, a special memory group scanning mode, and IF bandwidth selection by mode. Convenience features such as twin 12/24 hour clocks, a programmable on/off timer and 16 pre-programmed international shortwave bands are provided, while an SSB carrier offset function allows you to customise the receiver's audio performance. Complete with detailed instructions and a DC cable for connection to an external power supply.

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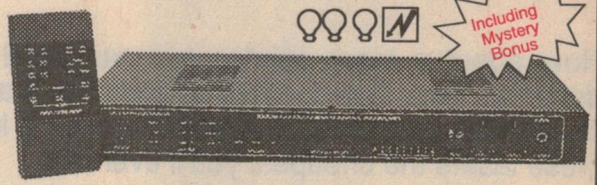
The Latest In Audio Design Technology!

Stereo Pre-Amplifier With Infrared Remote Control



After you build this kit you can really sit back and enjoy the finished product. You won't have to leave your chair once you have the remote control in your hand! Use it to adjust volume and balance or to select the program from 6 signal sources (phono, CD, Tuner, VCR, Aux 1 and Aux 2 and tape deck). The front panel of the amplifier features green LEDs to indicate settings made via the remote control as well as the selected program source. Comes complete with all components, hardware, PCBs, deluxe pre-punched case, pre-punched screened front panel and a deluxe remote control case and front panel to suit:

Cat K-5550 **$449**

The kit is supplied with:

- ☑ All components
- ☑ Case: Pre-punched and powder coated
- ☑ Front Panel: Punched anodised & screen
- ☑ Rear case section: Screened
- ☑ Remote control unit with anodised, punched and screened front panel
- ☑ Microprocessor chip plus IC socket to suit
- ☑ Mystery bonus

* Not available at all stores but may be ordered.

SILICON CHIP **Sept/Oct/Nov '93**

Including Mystery Bonus Valued At $40

180W Per Channel Stereo Amp

The latest and greatest in build-it-yourself hi-fi power amps, this clever design packs a real wallop for the price! Nevertheless, the massive heatsinks at each end plus its well-tried design philosophy will ensure an ultra-reliable result. The kit comes complete with everything you need - all required components: PCBs, case, heatsinks, transformers and all hardware.

The kit is supplied with:

EA **February/March '94**

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0.009% at 100W RMS into 4 ohms
Frequency Response: 3dB points: 10Hz to 100kHz
Signal To Noise Ratio (unweighted): >100dB with respect to 100W RMS
Input Sensitivity/Impedance: 0.8V/33k for 100W into 8 ohms
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Construction Project:

Compact 5mW Solid State Laser

How about a laser pointer you can build for under $50? We describe here how to build a compact, easy to make 3mW or 5mW solid state laser. The 5mW version is less than $80, making these lasers the cheapest you'll ever find.

by PETER PHILLIPS

Mention a laser project and many readers will think of the He-Ne (helium-neon) glass tube gas lasers which have been presented in *EA* over the years. These units were necessarily large, relatively expensive and needed a high voltage to operate.

The solid state laser has changed all that, and this project uses a continuous wave 3mW or 5mW assembly which includes an adjustable collimating lens.

Laser diodes are used in laser printers and compact disc players, and therefore have received a lot of attention in recent years.

The 5mW diode assembly used in this project is a type HL6711G and is described as a 670nm band AlGaInP gain-guided laser diode. It is intended as the light source for barcode readers, levelers, pointers and optical equipment. The 3mW version is similar, although it establishes its operating current in a different way.

As the lead photo shows, the project is packaged in a small plastic box, with the laser operated by pressing a button.

This makes it useful as a laser pointer, leveling guide or as a basic laser light source. However, the electronics and diode assembly are very compact, so you can house it in a variety of ways.

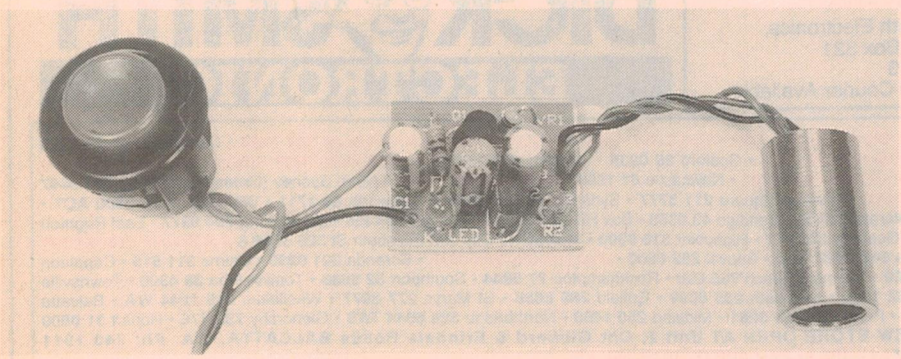
Your choice of laser diode power will depend on your budget and needs. However, very few people will be able to see the difference in beam intensity between both versions.

The laser diode

A solid state laser diode, although simple in appearance is a rather critical device to operate. See elsewhere in this article for precautions you MUST take to prevent accidental destruction of the laser diode.

The HL6711G device (and the 3mw version) incorporate a built-in monitor photodiode, used to provide feedback to the power supply regulator circuit. A critical aspect of laser diode operation is the forward current.

For the HL6711G, the threshold current (to start the lasing action) is typically 80mA. The maximum current is 95mA. A current of over 100mA instantly destroys the diode. The inbuilt monitor diode senses the output light power of the laser, and in this project, forms part of the current regulator circuit.



Here's a close-up of the PCB shown connected to the pushbutton and the laser diode assembly.

The optical output power of the HL6711G is rated at 5mW, a relatively high value, resulting in quite a powerful light source. Pulsing with a 50% duty cycle at a maximum pulse width of 1us will allow the diode to produce up to 6mW.

The maximum reverse voltage across the laser diode is 2V, and the device can operate over a temperature range of -10 to +50°C. The operating voltage of the laser diode is between 2.3V and 2.7V and the lasing wavelength is from 670nm to 680nm, which is the characteristic 'laser' red colour.

The regulator

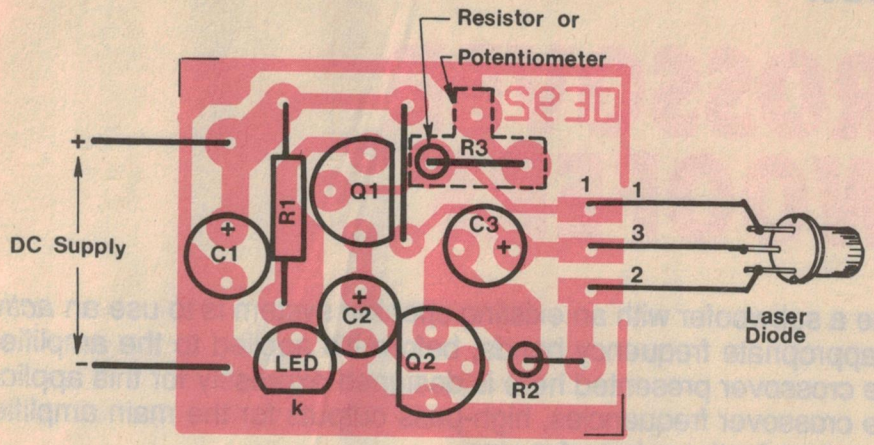
This circuit works in conjunction with the laser diode, and its operation depends on the action of the laser diode. So regard the laser diode as an integral part of the circuit.

The 3mW diode establishes its operating current with a different mechanism to the 5mW type, hence the different value of R3 for both types.

The laser diode current is via Rx, R2 and Q2, which together form a series regulator. A reference voltage is provided by LED1, and Q1 and Q2 form an error amplifier. R2 limits the maximum current able to flow in the regulator.

The circuit is controlled by the monitor photodiode in the laser assembly, accessed through pins 1 and 3. The amount of light falling on the photodiode varies the reverse current flowing in the diode, which in turn controls the current regulator and therefore the amount of current flowing in the laser diode.

For instance, if the light output from the laser diode increases, more reverse current will flow in the photodiode, increasing the voltage at the base of Q1. As Q1 is a PNP transistor, the increasing voltage



The layout of the PCB is shown here, larger than full size. Resistors R2 and R3 mount vertically. Take care not to accidentally swap the transistors, and double check the integrity of each soldered connection.

will cause it to turn off, as the base voltage is now closer to the emitter voltage. The emitter voltage is held at a nearly constant value by LED1.

The base current for Q2 is provided by Q1, so the current flowing through the laser diode will now be reduced. The quiescent point is determined by the laser diode action and the value of R3. If R3 is replaced with a 10k variable resistor, the output power of the laser can be varied. However you should only do this if you can measure the output power with a laser power meter.

Resistor Rx is chosen according to the supply voltage, as shown in the table with the circuit diagram. Its purpose is to reduce the voltage applied to the regulator circuit to around 5.5V. For voltages less than 6V, Rx can be zero. The three capacitors stabilise the operation of the regulator.

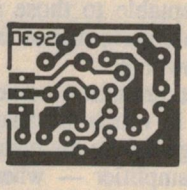
Construction

Before you start, see the warnings about how not to destroy the laser diode.

The PCB for this project is very compact and the component layout is screen printed on the board. There is one link, between Q1 and R3 and this should be fitted first. The laser diode is fitted last, but otherwise the order of component installation is not important. Note that resistors R2 and R3 are mounted vertically.

The PCB layout includes pads for a potentiometer in place of R3. Fit a potentiometer only if you can measure the output power of the laser diode with a laser power meter. Otherwise, you will probably destroy the diode.

It's important to fit the laser diode last, as it is susceptible to damage from electrostatic discharge (ESD). Take the usual antistatic precautions before handling the diode or touching its leads. That is, earth yourself first by touching the metal case of an earthed appliance. This will discharge any static voltage you may have built up. Use an earthed soldering iron to solder the leads. Once the laser assembly is connected, it will be protected by the rest of the circuit.



The artwork of the PCB, reproduced full scale for readers wanting to make their own. The design is copyright to Oatley Electronics.

In most cases, the kit will include the laser diode separate from the brass tube and collimator lens. In some cases pre-assembled laser diode assemblies might be available. The wiring colours for this type is shown in the circuit. Otherwise, you need to solder three leads to the diode. Make sure the soldered connections are good clean joints, and don't be tempted to use a socket for the diode. When the leads are soldered, put plastic sleeving over each connection to make sure the leads cannot short together.

Then insert the diode into the brass tube, as far as it will go. The diode will be a neat fit in the tube, and can be glued in place with an epoxy type glue. The collimator lens screws into the front of the tube.

Testing

Before you apply power to the circuit, make sure all connections to the laser diode are sound, and double check that the PCB is correctly wired.

As the table in the circuit says, the circuit can be powered from a range of DC voltages. However, resistor Rx has to be chosen according to the supply voltage you are using.

This resistor is not on the PCB and connects in series with the DC supply and the PCB. Note the power rating in the table for each value of Rx.

When you first apply power, the output of the laser diode will be unfocused. Obviously, don't look at it! Point the laser assembly at a wall a few metres away, then adjust the lens by screwing it in or out, until the beam is focused to a dot about 2.3mm in diameter.

If it's all working, there's nothing more except to assemble everything into a case.

Continued on page 86

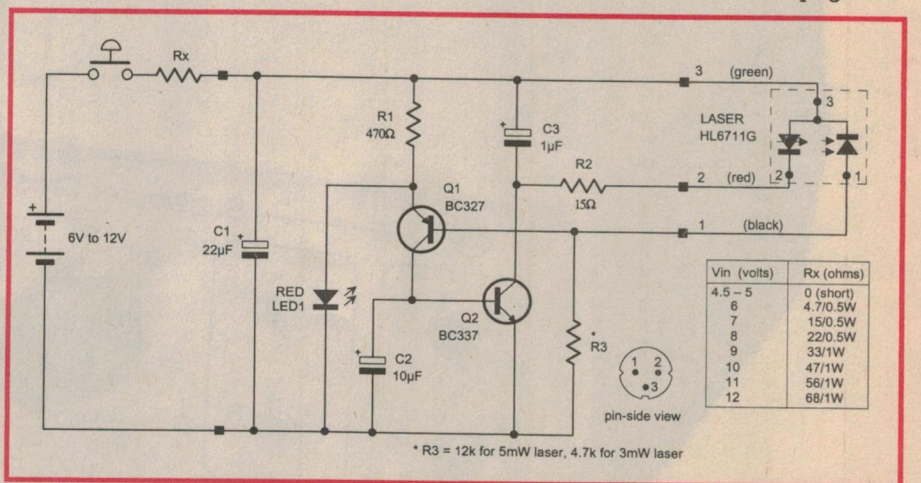


Fig.1: Transistors Q1 and Q2 form a current regulator that works with the laser diode to provide the correct drive current to the laser diode. Feedback from the laser diode is via an inbuilt monitor diode. The lead colours are for the 5mW, pre-assembled version, the pin connections are for the unassembled 3mW and 5mW diodes.

Construction project:

ACTIVE CROSSOVER FOR SUBWOOFERS

The most effective way to integrate a subwoofer with an existing speaker system is to use an *active* crossover to split the signal into appropriate frequency bands, before it's applied to the amplifiers and speakers. The two-way active crossover presented here is designed expressly for this application, and features three selectable crossover frequencies, high-pass outputs for the main amplifier, and an adjustable mono low-pass output for the subwoofer amp.

by ROB EVANS

In the May 1989 issue of *Electronics Australia*, we described a simple and low cost box of tricks called a 'Versatile Subwoofer Adaptor'. When connected to an existing amplifier's speaker terminals, this generated a suitable drive signal for a subwoofer amplifier and speaker combination. Thanks to the ease in which a subwoofer can be added to a hifi system with this approach, the adaptor appears to have been a very popular project over the years, with kit suppliers reporting a consistent demand for kits.

While the Subwoofer Adaptor is a convenient and inexpensive way to add a subwoofer to a existing system, though, there are a couple of quite distinct performance limitations with this approach. And quite understandably, these are not really acceptable to those seeking the best possible performance from a setup using a subwoofer.

The first limitation comes from the basic way in which the adaptor derives its input signal from the main (or host, if you like) amplifier — where it simply samples the signals appearing at the main amp's speaker terminals.

The problem here is that by definition, the signal must include the noise and distortion artifacts generated by the host amp, which will ultimately be passed on to the subwoofer. As also will any bandwidth limitations suffered by the main amp, by the way; if the amp begins to roll off the low frequencies below say 50Hz, ultimately so will the subwoofer.

In practice though, the above limitations really aren't too serious, since both the noise and distortion performance and the bandwidth of most contemporary amplifiers is of a standard that will impose no really *audible* restrictions on the subwoofer's sound. On the other hand, if your subwoofer system is designed to

extend down into the actual subsonic area (say, those frequencies below 30Hz), then the host amp's bandwidth limitations may well compromise that capability, when using the Subwoofer Adaptor.

The other restriction of the earlier adaptor's design is that it only offers a single low-pass output, rather than the complete set of low-pass and high-pass outputs that would be available from a true active crossover system. As such, this means that the subwoofer's output must be adjusted so that that it merely 'fills in' the low bass area that the main speakers cannot reproduce, and there is no real control over the combined output at what is effectively the crossover frequency. In this case, the natural low-frequency rolloff of the main speakers is acting as the high-pass filter.

While again this setup works surprisingly well with most systems, the main speakers are still attempting to handle the very low frequencies, and the 'crossover point' is at a fixed frequency as defined by the main speaker's low-frequency characteristics.

The new design

As you've no doubt gathered, our new Subwoofer Crossover has been designed to address all of the abovementioned restrictions, and to extract the best possible performance from a subwoofer based setup. It connects in the signal path between the main amplifier's preamp and power amp stages (see Fig.1), offers both low-pass and high-pass outputs which have matching rolloff and phase characteristics, imposes no restrictions on the subwoofer's very- low frequency response, and exhibits very low levels of noise and distortion.

Note that since the Subwoofer Crossover is designed to process the line-level signals which appear *after* the system's main volume control (that is, at a preamp's output), the unit will only suit those who use separate preamp and power amp stages, or who have an integrated amplifier which has facilities to break the signal path at that point. Nevertheless, feedback from readers suggests that this covers a large number of constructors, and in particular, includes many of those interested in subwoofer systems.

It's also important to point out that the crossover unit will not perform as intended when connected into an amplifier's tape loop facility — which may appear as a tempting method for those with fully integrated amplifiers. In this case, both the main and subwoofer systems will have a filtered response as expected, but the subwoofer's volume level will not follow that of the main speaker system, since a standard tape loop signal is *not* effected by the main amp's volume control.

Design considerations

Those readers familiar with active filter design will be aware of the extremely wide range of circuit configurations that can be used for a given application, and that each of these circuits has its own particular performance characteristics. The various topologies exhibit different stage gains, rolloff slopes, phase and group delay characteristics, transient response, and 'knee point' shape, which can make the job of selecting a suitable filter circuit a rather daunting process.

After some research and experimentation though, it soon became clear that a conventional second order Linkwitz-Riley configuration offered the best balance of attributes for the Subwoofer Crossover, and this was consequently used for both the low-pass and high-pass filter stages — see Fig.2 for the overall response plot.

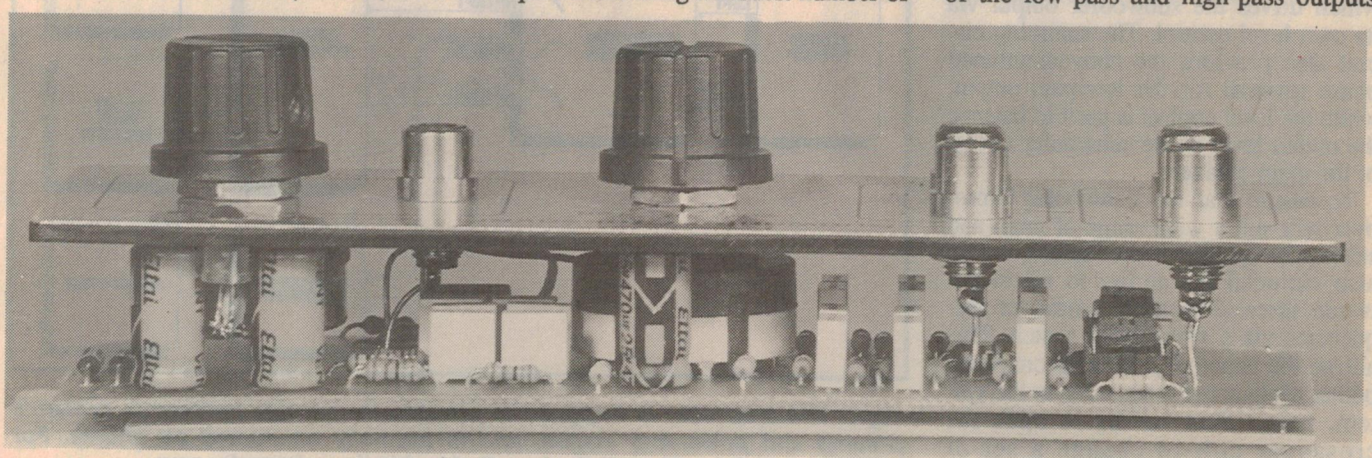
The resulting design is a relatively simple circuit using a modest number of components, which in turn, has led to a compact PCB design.

A second order filter was selected for the circuit after listening tests indicated that third or fourth order filters offered little sonic improvement in this case, in spite of their steeper rolloff slopes. With a moderate rolloff slope of 12dB per octave, the second order circuit suffers from far less phase shift than the higher-ordered circuits, and delivers a well- controlled transient (step) response. Our tests indicated that these latter factors play an essential part in how well a subwoofer integrates with the main speakers.

The Linkwitz-Riley configuration was chosen due to its desirable characteristics for audio crossover applications. As a variation on the popular Butterworth filter, the Linkwitz circuit offers the same basic characteristics (a flat pass-band response and moderate rolloff slope), with the exception of the shape of the transfer curve's knee point — the area where the curve changes from the pass-band to the rolloff slope.

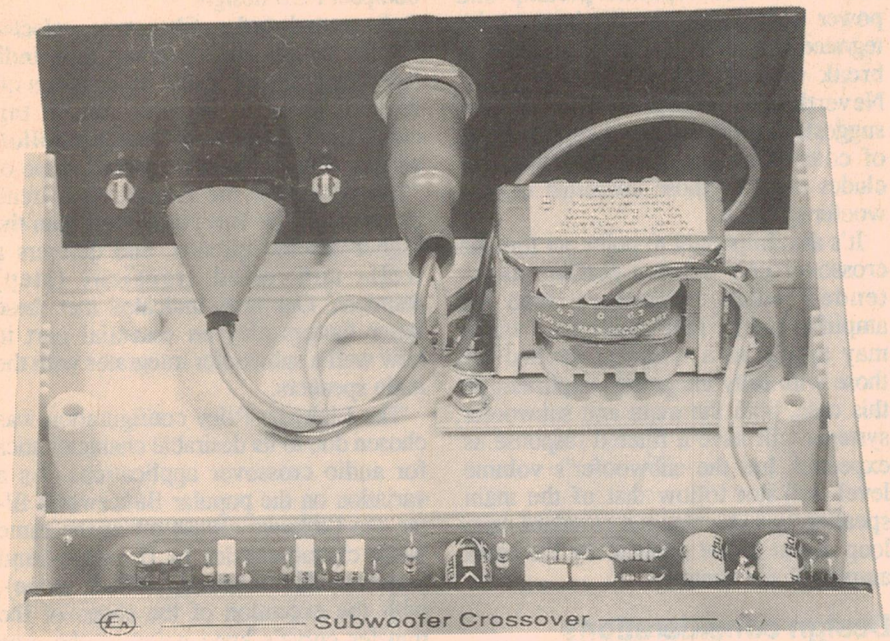
With this filter variation the knee point shape is rather flatter than with the Butterworth arrangement. But importantly, it will produce a flat overall response when the outputs of a low-pass and high-pass stage are summed — as is the case with a two-way active crossover, when the acoustic energy from the speaker systems combine. Conversely, summing the outputs of two equivalent Butterworth filters will produce a 3dB peak at the crossover frequency.

Note that the practical distinction between the two filter types is that the Butterworth's response has dropped by 3dB at the crossover frequency, while a Linkwitz filter's output will be 6dB down at that point. By the way the two types have a Q-factor of 0.7 and 0.5, respectively, and combining the outputs of the low-pass and high-pass outputs



For a neat final construction, the circuit board is supported by the RCA sockets (via short wire stalks) and the rotary switch.

Active crossover for subwoofers



The 240V AC supply from the IEC socket is connected directly to the transformer's primary via the fuseholder. Note the earthing lug on the transformer's mounting bolt, and how all mains connections are well insulated.

with either type will produce a deep hole at the crossover point unless one of the outputs is reversed in phase.

In addition to the most appropriate choice of filter type for the Subwoofer Crossover, we also needed to take a look at what facilities might be of most value for the unit. Again, these were determined by practical experience, plus a little hard-nosed thinking.

As there is little point in providing for two (stereo) subwoofer outputs (since whatever stereo information may be available at very low frequencies can't really be distinguished by the ear), we've provided a mono subwoofer output in this design. Here, the circuit simply sums the left and right input signals, then passes the result to a single low-pass filter which drives the subwoofer output via its own level control. The summing circuit also provides the abovementioned phase reversal for the low-pass output, while the level control is used to balance the output level of the subwoofer to that of the main speakers.

To ensure that the Subwoofer Crossover will suit a wide range of main and subwoofer speaker combinations, we've also included the ability to select between three alternative crossover frequencies via a front panel switch. This allows the user to try different crossover points while actually *listening* to the system, rather than having to open the crossover unit to change a set of jumpers, DIP switches or component values, then trying to work out how the sound may have changed. While at least one of the standard range of frequencies (70Hz, 90Hz or 120Hz) should suit a subwoofer-based system, they can be altered by changing component values in the normal way — as detailed later.

We have also taken some effort to make the crossover circuitry compact and largely self-contained, so that its construction is not dependent on a specific case or panel size. Since the circuit board is supported by the front panel controls and input sockets (see the photos of the prototype unit), the crossover assembly can be installed in the panel of just about any box, including an existing subwoofer amplifier; all that's needed is sufficient panel area, and a source of 12V AC power.

So there we have our new high-quality Subwoofer Crossover. It should offer the both the performance and flexibility to satisfy even the most serious subwoofer zealot, and can be built for a fraction of the price of an equivalent commercial unit.

Circuit description

As you can see from the crossover's schematic diagram, the circuit uses just three dual op-amps to produce the required low-pass and high-pass signals, with IC1, IC2 and IC3 dealing with the left, subwoofer and right signals respectively. Since the circuitry for the left channel signals is identical to that of the right channel, IC3's operation is not covered in the following circuit description.

Full bandwidth signals from the preceding preamp stage are applied to the crossover's input at SKT1 (left input), where they directly drive a unity-gain buffer stage formed by IC1a and input terminating resistor R1. In turn, the buffer's output provides a low impedance signal source for both the following high-pass filter (formed around IC1b) and the left/right mixer amp IC2a.

The high-pass filter is a conventional second-order 'Sallen and Key' arrangement, where IC1b (configured as a unity-gain buffer) drives both the feedback arm of the network and the output load. To provide a choice of three filter rolloff points while using only one pole of the 'crossover frequency' switch (SW1), the circuit uses three separate filter networks

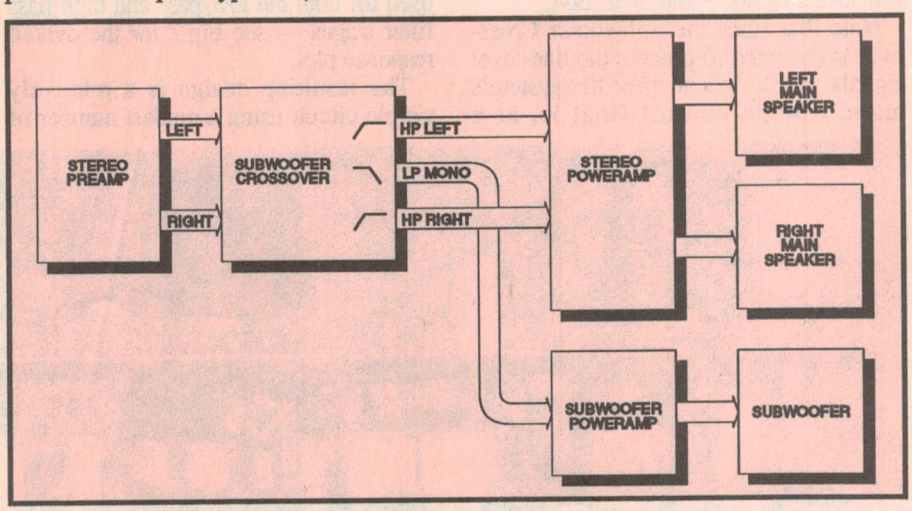


Fig.1: The crossover is designed to process the signals between a system's preamp and poweramp stages, and is normally connected as shown. For convenience, it could easily be installed inside the subwoofer amp.

which are permanently connected to the circuit (in parallel), but are only active when selected by SW1a.

Note that each network is effectively connected between the low-impedance outputs of IC1a and IC1b, and therefore won't influence the circuit until connected to IC1b's non-inverting input by SW1a. As you can see from the schematic, the 70Hz network is formed by C1, C2, R2 and R5; the 90Hz filter by C3, C4, R3 and R6; and the 120Hz circuit by C5, C6, R4 and R7. Also, R8 maintains a DC path to the op-amp's input while SW1a's wiper arm is passing between contacts, and R9 isolates and protects the op-amp's output.

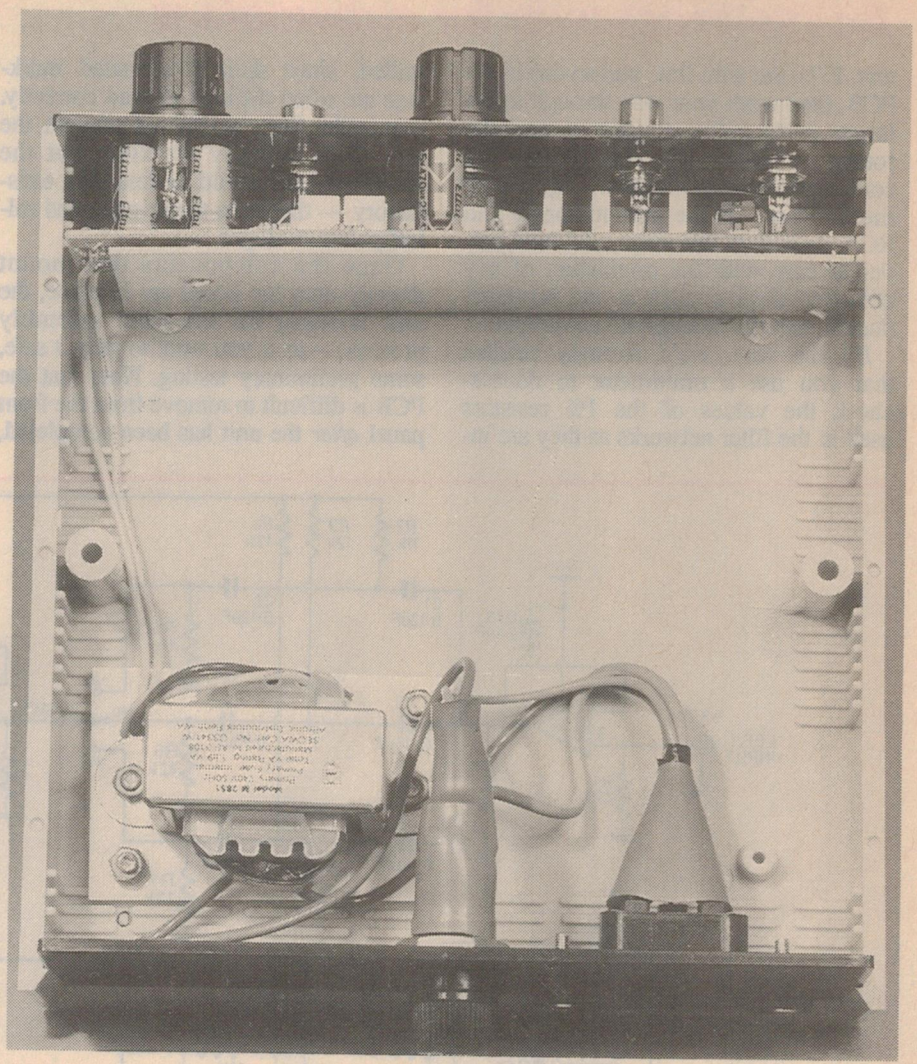
As is the case with most filter circuits, the equivalent low-pass stage is formed by simply interchanging the key elements in the network, while maintaining the value of each component. This can be seen in the circuit's low-pass (subwoofer) stage, which is based around IC2b and uses SW1b to select between networks. Here, the 70Hz network is formed by R13, R14, C7 and C10, the 90Hz circuit by R15, R16, C8 and C11, and the 120Hz section by R17, R18, C9 and C12. R19 terminates the op-amp's non-inverting input as before, and the subwoofer output level control (RV1) is driven via isolation resistor R20.

The mono input signal to this low-pass stage is derived by the inverting mixer stage based on IC2a, which is set to gain of around two (+6dB) by the combination of input resistors R10/R11 and feedback resistor R12. This stage combines the signals from the left and right input buffers IC1a and IC1b via R10 and R11, respectively, and also provides the necessary phase inversion for the subwoofer output — the phase response of the low-pass signal then matches that of the high-pass outputs, as discussed earlier.

The remaining parts of the schematic show the unit's power supply and the LED indicator circuit, with the latter depicted in two forms; 'LED option 1' and 'LED option 2'.

The first option shows LED1 connected between power supply rails VS+ and VS- via current limiting resistor R30, where the LED simply acts as a 'power on' indicator. LED option 2, on the other hand, uses SW1's remaining pole (SW1d) to activate LED1, LED2 or LED3 in order to indicate the selected crossover frequency (70Hz, 90Hz and 120Hz respectively).

The idea here is that option 1 is used when the crossover circuit is mounted in its own box, since the selected frequency is clearly shown by SW1's position relative to the front panel markings, and all we really need is a power indicating LED — as with our prototype unit. However when the crossover PCB is installed in the rear panel of a subwoofer amplifier, the three LEDs from option 2 can be mounted in the amp's front panel so as to indicate the selected crossover frequency in an unobtrusive manner.



As you can see, there's very little interwiring to be completed inside the case. The crossover assembly is quite self contained and only needs a source of 12V AC power from a suitable transformer.

The crossover's power supply is a very simple affair using a low cost 2851-type transformer, where the secondary voltage (nominally 12.6V AC) is half-wave rectified by diodes D1 and D2 and filtered by reservoir capacitors C19 and C20, resulting in split supply rails of around +/-17V DC. These rails are then applied to both the LED indicator circuit (as VS+ and VS-) and the additional filter stages comprising R31/C21, and R32/C22, which produce the V+ and V- supplies respectively.

Finally, note that the V+ and V- rails are used to directly power the three op-amps. These measure around +/-16V when loaded, and are bypassed at high frequencies by 0.1uF capacitors C33 to C36.

Construction

With the exception of the transformer and its associated wiring, all of the parts used in the crossover circuit mount onto a single compact PCB measuring 140 x 51mm, and coded 94flt8. As you can see from the pictures of the prototype unit there's hardly any interwiring to be completed, and the circuit board assembly is supported by the front panel controls and connecting sockets.

We used a standard 'small' plastic instrument case (150 x 160 x 65mm) for our prototype, although as already mentioned, you can fit the assembly into a panel of an existing amplifier's case — but more of this later.

Begin the construction by first installing the low profile components (resis-

Active crossover for subwoofers

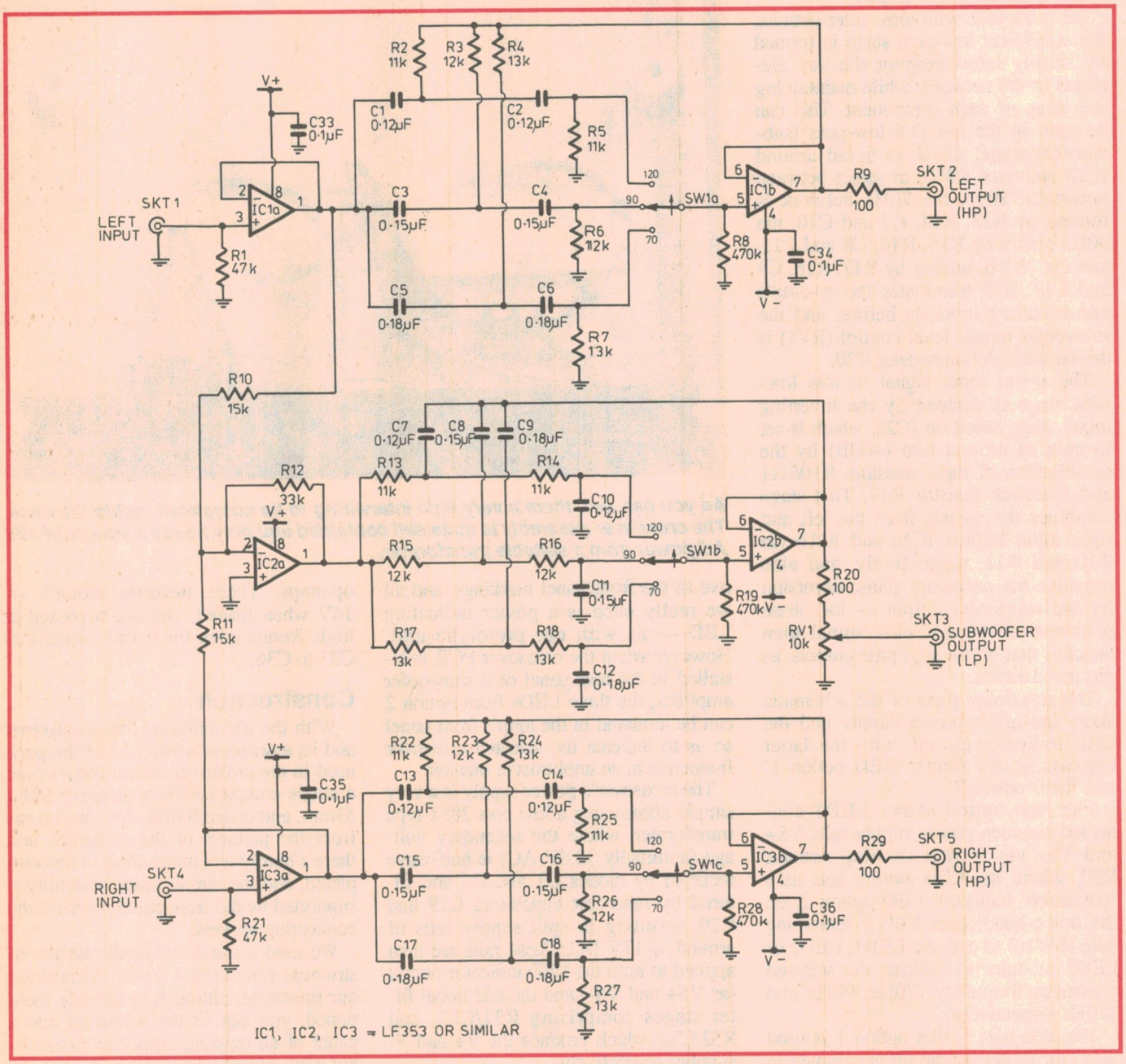
tors, IC's, the wire link, and so on) in the PCB, then work your way through to the larger parts (filter capacitors and the rotary switch), while referring to the component overlay diagram (Fig.3) at all times. Don't fit the potentiometer and RCA sockets at this stage, and take particular care with the orientation of any polarised devices such as the semiconductors and the electrolytic capacitors.

By the way, we'd strongly suggest that you use a multimeter to double-check the values of the 1% resistors used in the filter networks as they are installed, since their five-banded markings are often difficult to read correctly. A mistake here would not prevent the unit from actually working, but the audible results would be less than satisfactory — thanks to the mismatched roll-off points or slopes.

Once the components that mount directly onto the board are in place, the unit is ready for the final assembly process — or if you want to play it safe, some preliminary testing. Note that the PCB is difficult to remove from the front panel *after* the unit has been completed, so this is the time to track down any construction errors.

The next logical step is to fit the transformer into the box and complete the mains wiring, as shown in the schematic. In our prototype unit, the transformer was bolted to a small section of aluminium plate with a solder lug included under the nut at one side (using locking or 'star' washers), and the plate was then firmly bolted into the bottom of the case.

Once you have installed both the mains IEC socket and the fuse holder in the rear panel, carefully complete the 240V wiring while insulating any ex-



Above and right - the schematic: The crossover's circuit is quite straightforward, with IC1b and IC3b generating the high-pass outputs and IC2b producing the mono low-pass output.

PARTS LIST

Resistors

0.25W 5%: 3 x 470k, 2 x 47k, 1 x 33k, 2 x 15k, 1 x 3.9k, 3 x 100 ohms, 2 x 82 ohms
0.25W 1%: 6 x 13k, 6 x 12k, 6 x 11k
1 x 10k single-gang log pot

Capacitors

4 470uF 25VW PC-mount electrolytics
6 0.18uF MKT polyester
6 0.15uF MKT polyester
6 0.12uF MKT polyester
4 0.1uF MKT polyester

Semiconductors

3 TL072 or LF353 opamps
2 1N4002 power diodes
1 5mm LED (see text)

Miscellaneous

3 PC board, coded 94flt8
1 Plastic instrument case, 160 x 150 x 65mm
1 12.6V/150mA 2851-type mains transformer
1 4-pole 3-position rotary switch
2 Plastic knobs
5 Panel-mounting RCA sockets
1 Panel mounting IEC-type mains plug
1 3AG panel mounting fuse holder, with 250mA fuse

Solder lug, hookup wire, blank PCB (approx 130 x 50mm), aluminium plate, heatshrink or cambric tubing, nuts, bolts, lockwashers, etc.

SPECIFICATIONS

Distortion: 0.003% THD at 2V RMS output
Signal to noise ratio (unweighted): better than 95dB with respect to 1V RMS
Gain: 0dB for high-pass outputs; variable to +6dB for low-pass output
Crossover slopes: -12dB per octave
Phase linearity: matched for low- and high-pass outputs
Input impedance: 47k
Output impedance: 100 ohms
Maximum input level (one channel driven): 5V RMS

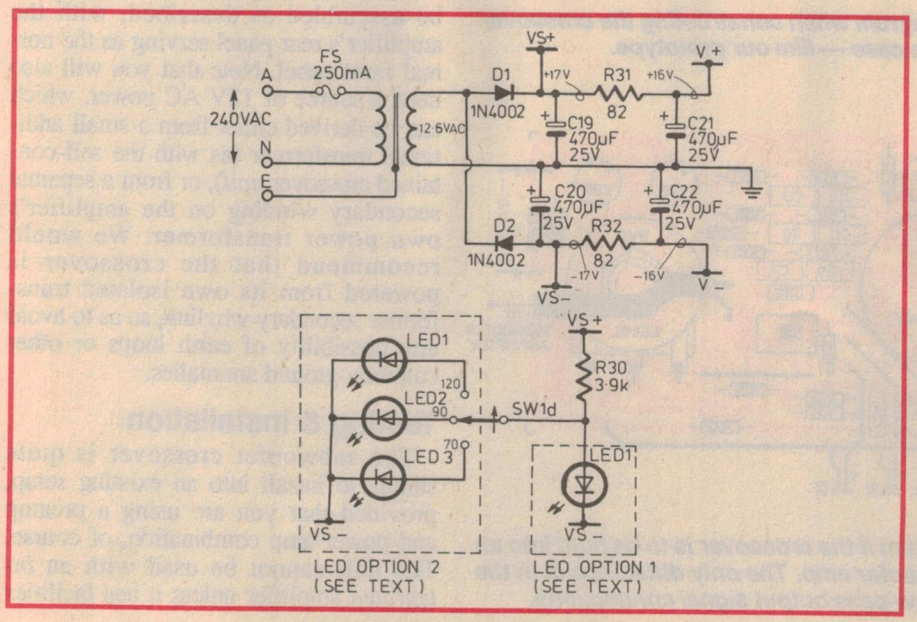
posed joints using heatshrink tubing or mains-rated sleeving as you go. Fit a mains-rated length of earth wire (green or green/yellow striped insulation) between the IEC plug's 'E' terminal and the solder lug on the transformer plate, then solder the transformer primary's blue wire to the pin marked 'N' on the IEC plug.

After that, connect the transformer's brown primary wire to the lug on the side of the fuseholder (the one nearest the panel), and run a short length of red mains-rated wire from the remaining fuseholder terminal (the 'tip') to the lug marked 'A' on the IEC plug. Then for your own safety, double check that the connections are correct and all exposed mains connections have been well covered.

Since the crossover's PCB assembly is a self-contained unit and only needs an 12V AC source to be fully functional, you can now temporarily connect the transformer's secondary wires to the PCB pads as shown in the component overlay, and perform the initial tests. Note that the circuit will operate quite happily without the RCA input sockets or subwoofer level control (RV1) connected to the board, so if you like to be thorough, you can even fully test the PCB assembly with appropriate audio signals at this stage.

For the initial tests though, just apply mains power to the unit. Then use a multimeter to check that both sets of supply rails are reasonably close to the specified voltage, and the output of each op-amp is sitting at zero volts. If this is not the case, quickly disconnect the power and double check your work against the component overlay diagram and the photos of the prototype.

Once you're satisfied that all is well, disconnect the transformer's secondary wires from the PCB, and start the final assembly process by installing the RCA sockets and the level pot in the front panel, as shown in the component overlay diagram and shots of the prototype. The indicator LED can also be fitted at this point, and should have its leads trimmed to a short length so that they won't foul the PCB; after which suitable light duty connecting wires can be attached.



Next, connect the ground lugs of the four input RCA sockets together using tinned copper wire, and then attach generous lengths of the wire (say, at least 40mm) to each socket's tip connection, and one to the ground lug connections near the input sockets. Then in a similar fashion, connect further lengths of the solid wire to the lugs of the level pot (three in all) and the two connections on the RCA output socket.

The PCB assembly can then be fitted to the front panel by locating the end of each wire in its matching PCB hole, and then sliding the board along the wires until the rotary switch mates with its panel hole. Note that while this is quite a straightforward process, it will be *much* easier if the wire 'stalks' are all trimmed to different lengths so that each wire can be located in its PCB hole in turn, without disturbing the others.

Also, make the wires vary in length across the PCB in a progressive manner, and shape those for the output socket as shown in the photographs since its PCB holes are slightly offset from its front panel position. And finally, you might like to fit a couple of extra washers to the rotary switch boss to promote the clearance between the front panel and the PCB — don't overtighten the switch locking nut though, as its plastic thread will easily strip.

When you're happy with the alignment between the PCB assembly and the front panel, the wire stalks can be soldered to the PCB pads and the excess length trimmed. The LED wires can also be soldered to the copper side of the board in the positions shown, and the knobs fitted to the front panel controls. For the best possible noise performance, you can also fit a section of blank PCB to the assembly to provide additional shielding against mains and RF interference.

As you can see from the interior shots of the prototype, this should be slightly

Active crossover for subwoofers

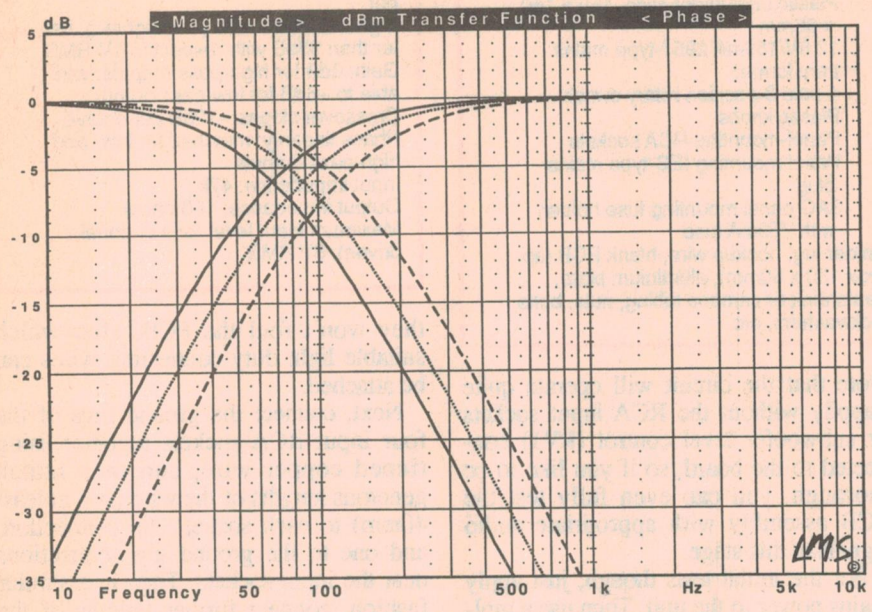


Fig.2: The frequency response of the crossover's low-pass and high-pass outputs. The solid, dotted, and dashed lines show the response curves for the 70Hz, 90Hz and 120Hz crossover points, respectively.

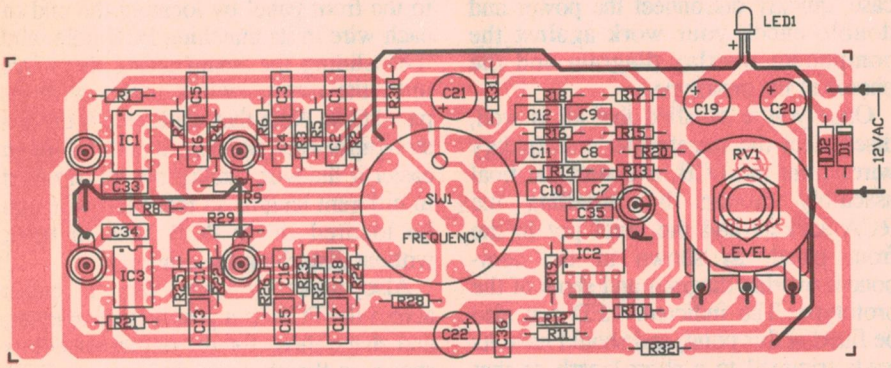


Fig.3: Follow this component overlay diagram when constructing the crossover as a free standing unit housed in its own case — like our prototype.

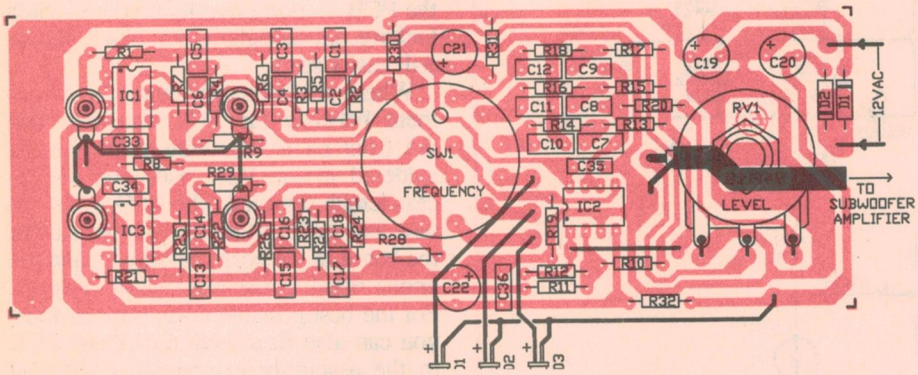


Fig.4: Use this component overlay diagram if the crossover is to be built into an existing amplifier case, such as a subwoofer amp. The only difference is in the wiring of the indicator LED(s) and the low-pass output signal connections.

narrower than the main PCB to allow for access to the AC input pads. It is positioned with the copper side facing away from the main assembly, and is connected (physically and electrically, to signal ground) via short wire stalks. You can use the actual-size PCB artwork presented here as a template for marking the shield board's mounting holes, by the way.

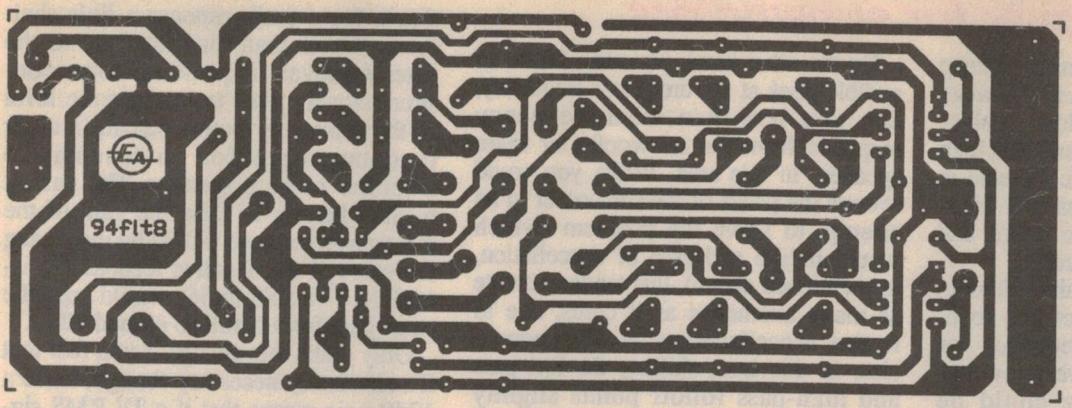
Finally, the completed front panel and PCB assembly can be installed in the case, and the transformer secondary wires soldered to the AC input pads. To avoid the possibility of signal earth loops, note that we have not included a grounding connection between the transformer mounting plate and the main board, as the circuitry will normally be earthed by the amplifier and/or preamplifier via the signal leads.

If you have elected to install the subwoofer crossover in the (say) rear panel of a subwoofer amplifier, the assembly process will be a little different, as you would expect. In this case, the subwoofer output signal goes directly to the amplifier's input rather than the crossover's output socket, and three indicator LEDs are wired to the PCB instead of one. This is shown in the alternative component overlay diagram Fig.4, where a length of shielded cable is wired to the subwoofer output connections, and the crossover frequency indicator LEDs are wired to SW1d's contacts as indicated. The LEDs can be installed in the amplifier's front panel and connected to the crossover board via a four-strand length of 'rainbow' cable, while the shielded cable is terminated at the amp's input connections — the crossover's RCA output socket is not required.

Other than that, the crossover unit can be assembled as described, with the amplifier's rear panel serving as the normal front panel. Note that you will also need a source of 12V AC power, which can be derived either from a small additional transformer (as with the self-contained crossover unit), or from a separate secondary winding on the amplifier's own power transformer. We would recommend that the crossover is powered from its own isolated transformer secondary winding, so as to avoid any possibility of earth loops or other common-ground anomalies.

Testing & installation

The subwoofer crossover is quite simple to install into an existing setup, provided that you are using a preamp and power amp combination, of course. The unit cannot be used with an *integrated* amplifier unless it has facilities



The full sized PCB artwork for those who wish to make their own.

to break the signal link between the preamp and power amp stages, as previously explained.

With a suitable system though, the crossover unit simply connects in series with the signal path between the preamp and power amp (using 'input' and 'main output' connections), while the subwoofer amp is driven from the crossover's 'subwoofer output' socket. The crossover frequency and subwoofer gain can then be adjusted to suit the speaker system and listening conditions, and the unit positioned out of sight until further adjustments are needed.

In practice, if the subwoofer amp has the same gain as the main amplifier unit, the drive to the main and subwoofer speakers will be of the same magnitude when the crossover's level control is around the 'three o'clock' position (for 0dB gain). There is another 6dB of drive signal available for the subwoofer amp when the control is advanced fully clockwise, which should be more than adequate for most subwoofer amp and speaker setups.

If you wish to confirm that the crossover is changing between the two frequency bands in the expected seamless manner, try connecting just the main speaker/amplifier system to the low and high outputs, and check the results. Connect the amplifier's (say) left channel to the crossover's left main output as normal, but connect the amp's right channel to the subwoofer output so that speaker is handling the low-end, while the left speaker is producing the remaining higher frequency signals as normal.

Then advance the crossover frequency switch to the highest setting (120Hz), adjust the 'subwoofer' level control to around the three-o'clock setting, and position yourself midway between the speakers to check the resulting sound. If all is well, this will be somewhat of an anticlimax, since the output from the two speakers should combine to sound as if they are one, with a normal tonal balance.

If the crossover is not exhibiting the expected phase, rolloff slope and amplitude characteristics between the two bands, the sound will be somewhat directionless and indistinct, or will suffer from quite audible peaks or dips around the crossover region. If you suspect that something is amiss in this regard, you really need to check the crossover's output signals with suitable test gear (oscillator, oscilloscope, etc.,) or an audio test set.

All being well though, you can re-connect the unit in the normal manner, adjust the controls to suit your setup, and enjoy the added dimension of your subwoofer as it smoothly integrates with the main speaker system under the control of the subwoofer crossover.

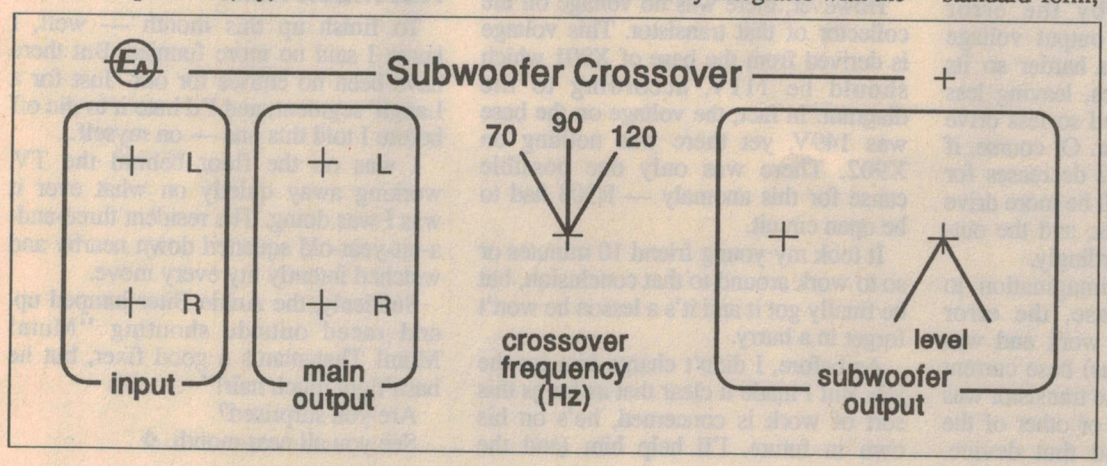
Custom changes

If you suspect that the standard range of crossover frequencies on the unit really don't suit you particular needs, these can be modified by simply changing the component values in the filter networks.

The rolloff frequency for the second order Linkwitz filters used here is equal to the inverse of $2\pi RC$, where both the two capacitors and two resistors used in the network are of the same value. While the new component values are easy to calculate using this equation, bear in mind that there are a couple of constraints on the range of components that will suit the circuit.

Firstly, the circuit board layout itself imposes a physical restriction of the size of the capacitors that can be installed in the PCB; these should be no larger than 0.22uF in the MKT style. This is because the next larger 'package' size is used for higher values in the MKT range, and a 0.27uF capacitor (for example) is almost twice as wide as a 0.22uF and just won't fit in the allocated space.

The other consideration involves choosing resistor values that will not compromise the noise or distortion performance of the circuit — which in its standard form, produces very clean sig-



The crossover's front panel artwork, shown here at actual size.

Active crossover for subwoofers

nals indeed. Your best bet here is to keep the network's resistor values in the range of about 10k to 22k, since lower values may cause the op-amps to overload at high signal levels (with a dramatic increase in distortion), and higher values will begin to generate a significant noise 'floor' and be more susceptible to interference.

Within the above constraints though, you should be able to select just about any practical crossover frequency for your unit. For example, a very low rolloff frequency of 50Hz could be achieved with the values of 0.18uF and 18k (49.1Hz, in fact), while a much higher crossover point of 200Hz would be realised with 68nF capacitors and 12k resistors (195Hz).

At this stage however, it's worth pointing out that if both your subwoofer and main speaker have a reasonably smooth response at lower frequencies, the point at which the two cross over will not be overly critical. In practice, the two speaker systems should have quite a substantial overlap in their natural (unfiltered) frequency response, and the crossover point just needs to be within this range. Consequently, one of the standard 70Hz, 90Hz and 120Hz settings should suit virtually all circumstances.

If you find that there is a noticeable *dip* in the acoustic response of your system around the crossover frequency, it may be that either the main, or subwoofer signal is being reversed in phase at some point and their acoustic energy is cancelling. As this is most likely to have occurred within the speaker wiring, try reversing the phase of the subwoofer signal by swapping the wires at its terminals.

On the other hand, you may detect an audible *peak* at the crossover frequency, due to a less than ideal frequency response from the subwoofer or main speakers in this area. While you could reverse the phase of the subwoofer in an attempt to solve the problem (which would induce a degree of cancellation, as mentioned above), this tends to create as many anomalies as it cures, due to further cancellation at nearby frequencies. In this case, shifting the low-pass and high-pass rolloff points slightly *apart* may be worth a try. This will reduce the energy sent to the speakers where the two frequency bands meet (the crossover area), without the penalties of phase cancellation. A slightly crude, but nevertheless effective way to do this is to increase the value of one of the network resistors in the low-pass filter stage, which will shift the subwoofer's rolloff point to a lower frequency.

This can be achieved by including a variable resistor in series with the network components R13/R15/R17, or in effect, between the output of IC2a and the input of the low-pass filter stage. The variable element should be a trimpot or standard potentiometer with a value of at least 20k, and can be wired in place of the link on the crossover's PCB.

The filter will then behave normally when the pot is set to its minimum resistance, as you would expect, while the pot's maximum setting will shift the rolloff point down in frequency by a significant degree. Note that while the 'knee' area of the filter's response will be somewhat flatter in shape when shifted in this way, this only makes the dip in the overall response a little shallower. Other than modifications to the filter turnover frequencies, some constructors may wish to increase the level of the subwoofer output signal, in order to compensate for an insensitive amplifier or bass speaker. The easiest method here is to raise the gain of the mixer/inverter stage (IC2a) by increasing the value of the negative feedback resistor R12 — a shift to 56k would raise the stage gain from 6.8dB to around 12dB.

Only make this change if you feel that it's absolutely necessary though, since a 12dB gain means that if a 2V RMS signal is applied to both the left and right inputs, IC2 will produce an output signal of about 9V RMS. The problem here is that you may end up with the subwoofer level control turned well down to compensate for the large signal, while IC2 is operating dangerously close to its overload point (around 10V RMS, in practice). As a rule of thumb, the circuit's gain structure is appropriate when the speaker systems are in balance with the subwoofer level control in the *upper* half of its travel.

And as a final point, if you wish to replace the TL072/LF353 ICs with chips that offer superior specifications, make sure that they are FET-input opamps, rather than bipolar devices such as the LM833 or NE5532. This circuit design relies on the fact that the FET op-amps offer a very high input impedance and a low input bias current; bipolar op-amps would not only develop significant offset voltages at their outputs, but also produce large transient signals (clicks and thumps) as SW1's wiper is moved between contacts. ❖

THE SERVICEMAN

Continued from page 47

tances R904 and FR901 (a fusible resistor). However this base current can be bypassed to ground by the error amplifier, X902. If the output voltage rises, X902 is turned on harder so its collector current increases, leaving less base current for X901 and so less drive for the regulator transistor. Of course, if the current through X902 decreases for any reason, then there will be more drive for the regulator transistor, and the output voltage will rise accordingly.

It didn't take much imagination to realise that, in this case, the error amplifier had ceased to work and was not bypassing the (surplus) base current to X901. We knew that the transistor was OK, so it had to be one or other of the few components around that device. Zener diode D905, in the emitter, was the first suspect; but quite unexpectedly, this was working normally and the voltage on the emitter of X902 was 6.6 volts — exactly as set by the zener.

However, there was no voltage on the collector of that transistor. This voltage is derived from the base of X901 which should be 111V, according to the diagram. In fact, the voltage on the base was 149V, yet there was nothing on X902. There was only one possible cause for this anomaly — R903 had to be open circuit.

It took my young friend 10 minutes or so to work around to that conclusion, but he finally got it and it's a lesson he won't forget in a hurry.

As before, I didn't charge him for the job. But I made it clear that as far as this sort of work is concerned, he's on his own in future. I'll help him (and the other chap) with their difficult problems, but if they can't handle the simple ones like this, then together we've wasted the whole of last year at the College.

Not much hair!

To finish up this month — well, I know I said no more funnies. But there have been no entries for our 'Just for a Laugh' segment, and I'd hate it to die off before I told this one — on myself...

I was on the floor behind the TV, working away quietly on what ever it was I was doing. The resident three-and-a-bit-year-old squatted down nearby and watched intently my every move.

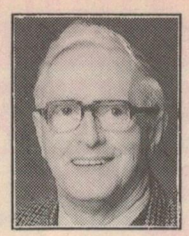
Suddenly, the Ankle Biter jumped up, and raced outside shouting "Mum! Mum! That man's a good fixer, but he hasn't got much hair!"

Are you surprised?

See you all next month. ❖

SHORTWAVE LISTENING

with Arthur Cushen,



Many amateurs also shortwave listeners

No doubt most radio amateurs would have been introduced to their hobby through shortwave listening, which provides an excellent way of finding that the world outside offers a multitude of voices, languages, programmes and news. It's understandable that this encourages many to make their own communication with fellow enthusiasts in all parts of the world.

The shortwave listener nowadays tends to fall into two categories: those who listen for programmes only, for the enjoyment of tuning the world, and those who are in the hobby to offer assistance to international broadcasters and broadcasters in general on medium and shortwave. The latter group are generally more involved in writing reception reports and giving the station an idea of their coverage in this part of the world.

In recent years, there has also been an increasing interest in utility listening and as well, television and FM reception over long distances.

Although fax is often used for dispatch of reception reports and reply from stations, verification cards are still valued. At a Convention of the South Pacific Association of Radio Clubs held near Oamaru NZ, which was attended by members from all four clubs in Australia and New Zealand, those attending agreed that we are still gatherers of collectables — we like to get a verification card, letter, sticker or pennant to prove our reception of the broadcast.

International broadcasters are aware of the speed of shortwave information and many carry their own media programmes, DX sessions, letterbox, etc.

Listening in general has been made easier since the introduction of keypad receivers and digital readout information. Many listeners, up to 1980, struggled with calibrated analog dials, but following Sony's introduction of the 2001 keypad receiver, finding stations has become easier and now almost all communication equipment has adopted keypad operation and memories. Of course, the manufacture of shortwave equipment has spread to many countries since the introduction of the Japanese receivers.

Aerials are also no longer essential for shortwave listening, but to improve the signal to noise ratio on shortwave they are a distinct advantage. On mediumwave, many listeners in a city location can use a loop to increase signal strength on that band. ❖

Clubs affiliated with the South Pacific Association of Radio Clubs will gladly supply information about their activities. Here are the names and addresses:

AUSTRALIA:

DX Australia,
PO Box 285.
MT WAVERLEY, VIC 3149

Southern Cross DX Club,
PO Box 1487,
ADELAIDE, SA 5001

NEW ZEALAND:

New Zealand Radio DX League,
PO Box 3011,
AUCKLAND.

New Zealand DX
Radio Association,
C/- Mr R. Dickson,
88 Cockerell Street,
BROOKVILLE, DUNEDIN.

AROUND THE WORLD

BOLIVIA: In South America a 10kW shortwave transmitter is under construction in Sucre, Bolivia to broadcast to the Quechua community of that area. Sucre has an interesting history. It is actually the capital of Bolivia in name only — the largest city in that country is La Paz, generally regarded as the commercial capital of Bolivia.

LIBERIA: Some interesting developments have been announced in broadcasting gospel programming into West Africa following the destruction of ELWA Monrovia, when the 50kW transmitters were destroyed in the war in 1990. Some two years later transmissions were back on FM and in more recent times a 10kW unit has been received using 4760kHz around 0600UTC. In the same area a shortwave transmitter is to be installed in Benin.

MALDIVES: A group of 13 islands in the Indian Ocean has returned to shortwave broadcasting after an absence of five years.

Plans were announced recently for the installation of a transmitter to serve the neighbouring countries and tests have been completed on 7350kHz between 0400 - 0800UTC. English announcements were heard by listeners in South Asia, to which the transmission is beamed and a regular service has commenced. Early reception of the original Radio Maldives was heard many years ago on 4740kHz.

PALAU: KHBN Koror continues to be heard with best reception on 9830kHz at 0900UTC, with English identification and programmes in Chinese. Palau has been granted independence as from October 1 and has an interesting history — it was sold by Spain to Germany in 1899, placed under Japanese mandate in 1920 and occupied by American Forces in 1944.

USA: WEWN Birmingham Alabama broadcasts in English to the United Kingdom from 0800 - 0900UTC on 7465 and 12,160kHz. The station also broadcasts to Western Europe 0900 - 1000 12,160kHz; to Korea 1000 - 1100 9370kHz; and to Japan 1100 - 1200 on 9370kHz.

Radio Marti which is operated by the Voice of America and broadcast to Cuba, has introduced some new frequencies. It was heard testing on 6055kHz at 0500UTC and according to their verification the transmitter is in Bethany, Ohio. The schedule is: 2300 - 0600 on 9525kHz; 0600 - 1200 6030kHz; 1200 - 1400 9600kHz; 1400 - 2300 11,930kHz. There is no transmission on Monday from 0400 - 1000UTC.

This item is contributed by Arthur Cushen, 212 Earn Street, Invercargill New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time and 12 hours behind NZ Standard Time.

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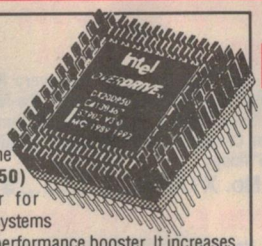

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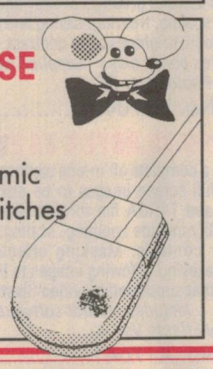

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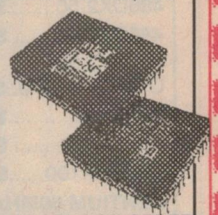

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- Memory configuration from 1 MB to 96MB using combinations of 80ns 256K, 512K, 1M, 2M, 4M and 16M SIMM modules. Uses one 30-pin and two 72-pin DRAM modules in multiple configurations
- Seven 16-bit slots, two master VESA slots, and one slave VESA slot

VESA LOCAL BUS

CAT.	DESCRIPTION	PRICE
X18002	IDE SUPER I/O	$39
X18099	VESA 1 Meg TRIDENT	$139
X18100	VESA CIRRUS 5428	$199
X18184	VESA PARADISE 1Meg	$299
X18186	VESA IDE Cache Cont	$349
X17071	VESA SCSI 2, IDE, Floppy, Multi I/O	$299
X18087	VESA WD Accelerator Video Card	$209

P.C.I.

CAT.	DESCRIPTION	PRICE
X17900	PCI 1M VGA	$299
X17910	PCI IDE CONTROLLER	$99

DIAL CORD

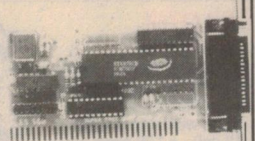
Ultra strong 1 M in length

H10510.....**$2.95**

SUPER FAST

uses 16550 CP Uart CARD

1xRs232 High Speed Serial Card

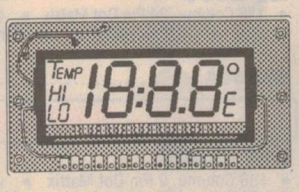


- *COM PORTS 1-4 address.*
- *UAR enabling*

x18141.....**$59.00**

CPI.NSCANR

DOT MATRIX LCD TEMPERATURE/CLOCK MODULE



This Temperature Clock Module feature thermometer display in 3½ digits for temperature with °C or °F indicator. Sampling cycle at 10 seconds or 1 second. Measurable range from 20°C to 70°C Has temperature alarm settings by 1°C (or 1°F). Clock display HOUR and MINUTE. Powered by 1.5V (UM-3 size battery).

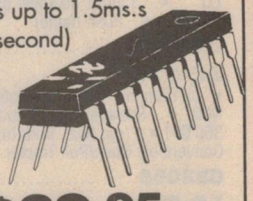
Cat No. A10072 **$29.95**

SPECIFICATIONS:

Module dimension:.....68x35x20mm
Screen Display Area:.....48x15mm
Digit Character Size:.....12mm Height
Battery supply:.....1.5V (UM-3 size battery)

A/D CONVERTER CHIP

ADC 08061 at rates up to 1.5ms.s (Megasamples per second)



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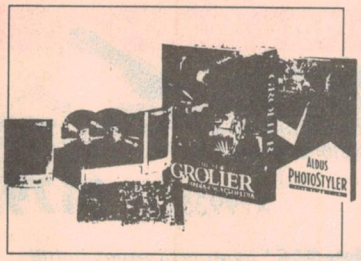
SOUND BLASTER MULTIMEDIA RANGE

SOUND BLASTER CD8 DISCOVERY PACK



Combine the Sound Blaster Pro Card with a Sony Dual Speed PhotoCD compatible, Multi Session CD-ROM Drive for maximum effects.

- Includes Stereo Speakers • Creative Software • CD Titles - The New Grolier Encylopedia and Aldus PhotoStyler SE

Without Return to Zork CD.....$549.00 Cat No. X17162
With Return to Zork CD.....$599.00 Cat No. X17160

SOUND BLASTER CD16 DISCOVERY PACK

Combine the Sound Blaster 16 Card with a Sony Dual Speed PhotoCD compatible, Multi Session CD-ROM Drive for maximum effects.

- Upgradable to Advanced Signal Processing Technology and Wave Blaster • Includes Stereo Speakers and Dynamic Microphone • CD Titles - Children's Screen Singer, The New Grolier Encylopedia, Aldus PhotoStyler SE, Aldus Gallery Effects Vol. 1, Altamira Compose SE, Kai's Power Tools & HSC Digital Morph • *Includes bonus disks - Lemmings & Indy 500 on 3.5" floppy.*

Cat No. X17208.....$629.00

SOUND BLASTER CD16 PERFORMANCE PACK

Combine the Sound Blaster 16 Card with CR563B - Creative Double Speed PhotoCD compatible, Multi Session CD-ROM Drive for maximum effects.

- Upgradable to Advanced Signal Processing Technology and Wave Blaster • Includes Stereo Speakers and VoiceAssist software • CD Titles - The New Grolier Encylopedia, Return to Zork, Aldus PhotoStyler SE, and Creative Screen Singer

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Same Hardware bundle as Discovery Pack but packaged with the following CD Titles: • CD Titles: The New Grolier Encylopedia, Iron Helix, Rebel Assault, Return to Zork, Sim City 2000 , F117A, Railway Tycoon, Civilisation & Silent Service • Bonus - Lemmings & Indy 500 on 3.5" floppy.

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SOUND BLASTER EDUTAINMENT CD16

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VIDEO BLASTER SE

The special edition Video Blaster is completely revised, doing what the original did and more. Supports NTSC, PAL and S-Video systems, with software selectable video sources from 3 composites or 1 S-Video input. Allows text and graphics overlay and masking effects. Also provides live image scaling, freezing, saving and loading. Other controls include hue, saturation, brightness and contrast. Includes DOS & Windows software. *Includes bonus disks - Supplied with Microsoft Video for Windows & Aldus Photostyler SE.*

Cat No. X17040.....$495.00

VIDEO BLASTER FS200 NEW

This is a complete all-in-one capture, compression and playback card. It allow full screen images to be displayed. PCX, TIFF, BMP, MMP, GIF, JPEG and TARGA file formats are supported. Special visual effects capability include zooming, scaling, flipping , fading, slow motion and colour controls. Masking effects includes as color keying and chromakeying- allowing images to be superimposed onto other graphic file format supported by Video Blaster FS200. Captures up to 320 x 240 pixels. *Includes control software, Aldus PhotoStyler SE and Aldus Gallery Effects Vol. 1*

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C92160.....$279

LX-850
• 80 Column, 9 Pin Dot Matrix • 240 Cps Draft/48 Cps NLQ • Smart Park feature • Push tractor
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• 136 Column, 24 Pin Dot Matrix • 330 Cps Draft/110 Cps LQ • Smart Park feature • Push tractor
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• 136 Column, 24 Nozzle Ink Jet • 600 Cps Draft/198 Cps LQ • Smart Park feature • Push tractor
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LQ-100
• 80 Column, 24 Pin Dot Matrix • 200 Cps Draft/72 Cps LQ • 3 fonts, 50 sheet paper cassette • Smart Park feature • Push tractor
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C22068.....$625

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• 80 Column, 24 Pin Dot Matrix • 330 Cps Draft/110 Cps NLQ • Scalable Fonts 8 to 32 pt • 11 LQ fonts/360 x 360 DPI • Top, Rear, Bottom and Front paper feed paths. • Convertable Push/Pull Tractor
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LQ-1070
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LQ-1170
• 136 Column, 24 Pin Dot Matrix • 350 Cps Draft/110 Cps NLQ • Scalable Fonts, 8 to 32 pt • 11 LQ Fonts/ 360 x 360 DPI • Convertable Push/Pull Tractor • Top, Rear, Bottom and Front paper feed paths.
C22127.....$1499

LQ-1060
• 136 Column, 24 Pin Dot Matrix • 292 Cps Draft/98 Cps LQ • Colour Standard • Smart Park Feature
C22096.....$1395

LQ-2550
• 136 Column, 24 Pin Dot Matrix • 400 Cps Draft/133 Cps LQ • Colour Standard • Smart Park Feature/ Push Tractor
C22064.....$2630

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C22087.....$3995

DFX - 8000
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C22310.....$5999

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EPSON LASER EPL-5200
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LATEST TECHNOLOGY - DX4-100 UPGRADABLE MOTHERBOARD SUPPLIED

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- 4MB of SIMM RAM exp to 128MB
- 255MB Hard Disk Drive
- 1.44 Floppy Disk Drive
- 14" Supa VGA Monitor-1024 x 768 resolution
- The popular Microsoft Ergonomic Mouse
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- DOS 6.2 & Windows 3.11 all preinstalled.
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- Augat Zero force socket set your system up for future DX4-100MHZ or Pentium CPU upgrade.

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Construction project:

The IMP - 3

In this final part of our current series on the IMP loudspeaker testing system, we'll tell you how to assemble the hardware module, and provide details on the best way to get the complete system up and running.

by ROB EVANS

As discussed in the previous articles on the IMP system, its free-standing module converts the incoming analog data into a 12-bit digital format, stores this in an on-board static RAM, and when the sampling run has finished, passes the results to the PC via the standard printer port. As you can see from the associated shots of the prototype, the module's front panel holds input sockets for mic and probe inputs, a test pulse output socket, a level control for each type of input, and a couple of indicator LEDs. The socket for the PC's printer port and one for the DC inlet are located on the rear panel.

The IMP circuitry is housed in a standard 200 x 160 x 70mm plastic instrument case, and uses a double-sided printed circuit board (PCB) measuring 165 x 97mm and coded 94imp4. This mounts directly onto the bottom half of the case.

The actual construction procedure is quite straightforward, particularly if you are using a commercially produced PCB with plated-through component holes. In this case, the parts can be installed in the board in the usual manner, where solder joints only need to be completed on the *non-component* side of the PCB — the connections to the top layer tracks are made via the plated-through holes.

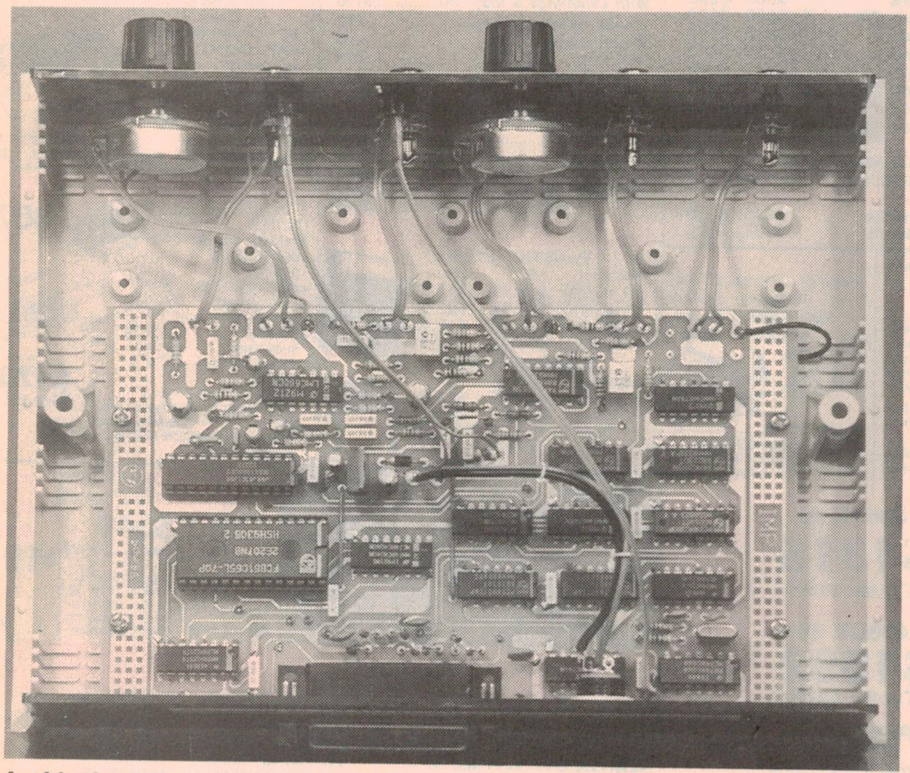
If you have elected to make your own PCB on the other hand, you will need to devise an alternative method for joining the tracks on the top and bottom layers. The somewhat tedious solution used for our prototype IMP circuit board was to insert small strands of wire into the critical holes, solder the top connection to the pad (away from the hole), then install the component and solder both its lead and the wire to the bottom pad. As it happens, the wire was simply a single strand from a light duty multi-stranded hookup wire.

This method is not really as time consuming as you might think, since a large number of 'through' connections can be made using existing component legs — for example, a resistor's lead can usually be soldered on both sides of the board. And of course, only a proportion of the PCB's holes are used to connect the top and bottom tracks, and therefore must be converted to through connections. The other holes just have their bottom pads soldered in the normal way.

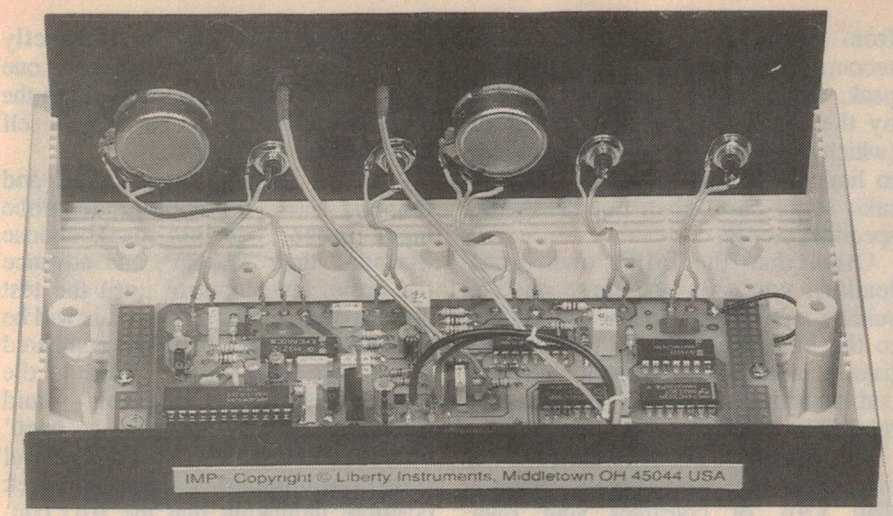
An alternative, and much less fiddly method for making the through connections, is to use special PCB eyelets in the critical holes, rather than fine strands of wire. These are very small tin-plated copper tubes, which can be inserted into the PCB holes and first soldered around the outer edge to the top PCB pad. When the components are then installed, their legs now pass though the eyelet rather than the PCB hole itself, and both the eyelet and the leg can be soldered to the bottom pad.

We recently received a sample of such a product from Queensland distributor Palmtech. Their eyelets measure 2.2mm (long) by 1mm with an inside hole diameter of 0.7mm, and will cost you about $6 for a pack of 50. Palmtech can be contacted on (077) 463 109 or fax (077) 463 198.

Regardless of which method you might use for forming the plated-through holes, you will need to find their locations on the PCB. First, note which hole pads on the top side of the board are actually joined to tracks (as these will be through connections), then consider the component that will be installed in these holes. If the component legs are sufficiently exposed to allow



Inside the IMP module. The double-sided PCB mounts directly onto the bottom of the case, with a section of blank circuit board sandwiched underneath for shielding purposes.



The module's PCB holds all of the circuitry with the exception of the RCA sockets, pots and LEDs installed in the front panel — these are connected using light duty hookup or 'rainbow' wire.

soldering on the top side of the board (as is the case with most of the resistors), then there is no need to convert the related holes to a through connection — the component leg will do the job. However, if the legs will not be exposed when the component is fitted to the board, a through connection must be made. Examples of this situation are the MKT-style capacitors, and any IC sockets that may be used — we therefore only used sockets on the A/D converter (IC18) and the SRAM (IC19).

Once the plated-through holes situation is settled, you can install all the components into the PCB in the normal manner, while referring to the component overlay diagram. Take the usual care with the static-sensitive CMOS devices, and the orientation of any polarised parts (semiconductors, electrolytic capacitors, etc.), and work your way through from the low to high profile components. Resistors R29 to R35 are installed 'on-end', by the way.

Note that both C10 and C7 near the A/D converter are small monolithic-type bypass capacitors, and there are two wire links near the centre of the board which should be formed with insulated wire. Additional components R24 and C26 are connected with LNK1, which probably won't be needed in most circumstances — you could however, include a switch on the rear panel to select and de-select this feature. Also note that we've used PCB pins at the external connection points on the board — which including the LED wiring, adds up to 20 locations.

The completed board assembly is now ready to be installed into the bottom of the case. Since we're dealing with a plastic box, we would recommend that you also fit a section of blank PCB under the IMP board, as additional shielding from induced mains hum and other interference. This should be a similar size to the main PCB, be installed with the copper side facing *down*, and must be electrically connected to ground on the IMP board via a short length of wire.

The simplest mounting method is to drill holes into the shielding board which match those of the IMP PCB, then screw both boards onto the case's mounting pillars using four screws — you may need to use small spacers between the two boards, however. In our prototype unit on the other hand, we removed (trimmed) all of the pillars lying under the IMP board, then just sandwiched the shielding board underneath while using a section of thin foam sheet as packing. With this latter method, the shield PCB needs to be narrower than the main board (to allow for the four mounting pillars), and the packing is fitted between the shield board (copper side) and the case.

Next, the various parts can be fitted to the front and rear panels, and wired to the IMP board as shown in the component overlay diagram and interior shots of the prototype. This wiring can be completed with normal hookup or 'rainbow' cable, since the signal lines operate at a relatively low impedance and are not really susceptible to interference. Make sure that the wiring between the DC power input socket and the PCB matches the polarity of the plugpack unit that you're planning to use, and double check that the other wiring is connected as specified.

Finally, the ICs can be carefully installed into their matching sockets, if you haven't already done so. Your IMP module should then be ready to be tested.

Testing...

Before connecting the IMP module to the PC's printer port, there are a number of checks that you can perform. First, connect the power from the plugpack and verify that the 'power' LED is illuminated, and the 'sample' LED is off. If there is no action from the power LED, check the polarity of both its wiring and that of the DC input from the plugpack.

If all is well, you can then check the voltage at a couple of key points around the circuit board, starting with the main +5V supply line. If this is stable and measures close to 5V, then turn both level controls fully counter-clockwise and check that the output pin of each op-amp within IC17 (pins 1, 7, 8 and 14) is at the 2V reference level. A prob-

The rear panel holds the DC power inlet socket, the DB25 type connector for the computer's printer port interconnecting cable, and the obligatory copyright label.

lem with *all* of these levels would indicate some error with the 4V reference supplied by the A/D converter IC18 — remember that the 2V reference level is derived at IC17c.

Once you are happy that the module's power supply and its derivatives are intact, you're ready to connect the PC and let the IMP software take charge. However, this may be a good time to construct the probes for the high level inputs, as shown in Fig.7.

These are quite a simple arrangement as indicated in the diagram, where the series connected 47k resistor acts in conjunction with the probe input's 2.2k terminating resistor to form a 'divide by 22' (-26dB) attenuator. This has the effect of bringing potentially large amplifier output signals down to a more manageable level for the module's input circuitry, and also presents a reasonably high input impedance to the driving signal — that is, the point being monitored.

Note that while you could simply install the 47k resistor in the IMP module itself — say between the PCB and the probe input socket — this would mean that the cable is then functioning at a high impedance over its full length, and may be more susceptible to interference during some tests.

The lead itself can be formed from shielded audio cable as indicated in the diagram, and can be up to a few metres in length, depending upon the capacitance of the cable.

If you use the IMP module without the above probes, remember that the input impedance is only about 2.2k, and this may degrade the performance of any line-level stage that is under test — say, an active filter section for example. More importantly however, the IMP module's input stage may be damaged by excessive signal peaks from an amplifier, as the maximum recommended input signal is just 2V peak. While this risk is greatly reduced by the input resistors R26 and R27 (which allow IC16's protection diodes to limit the signal), you really need to take some care when not using the specified probes.

Other than the IMP's own input lead(s), you will of course need a suitable cable for connecting the module to the PC's printer port. This should have a male DB25 connector at each end, as both the computer and the IMP module have female connectors.

You can either purchase the cable as an off-the-shelf item (usually for less than $20), or construct your own using DB25 IDC crimp connectors and a suitable length of 25-way IDC flat ribbon cable. While the IMP module is generally used in close proximity to the PC, you can in fact use quite a long interconnecting cable — ours measured 3.5m, and did not cause any communication errors.

Finally, you'll need an appropriate plugpack supply to power the IMP module. This should have an output in the range of 9V to 12V DC, and since the module draws very little current, it need only be rated at 100mA (or more).

IMP time

If you've purchased the IMP software prior to building the module, chances are that you will already be familiar with its basic operation, since many of the functions can be used without the IMP module connected. By following the information files (*impread.me*, *impulse.doc*, etc.,) supplied on the disk, and by making use of the on-line help system, you should then have little trouble in making a couple of preliminary sample runs with the module connected to the PC.

A quick way to check that the system is operating correctly is to directly sample the test pulse, by connecting one of the probe inputs (say, probe 1) to the 'out' socket via the probe lead — self analysis, you might say...

With the IMP software loaded and running, select the appropriate probe input (probe 1, in this case), choose 'Acquire' then 'Repeat', and advance the probe level control until the test pulse appears on the screen. This will be somewhat rounded in shape compared to the test pulse itself — due to the module's anti-aliasing filter — and should eventually instigate a 'beep' from the computer's speaker as the level control approaches its three o'clock position, indicating that the A/D converter has run out of amplitude range.

On the other hand, if you find that the screen will not display a trace, and after a short period the message 'IMP MODULE DOESN'T RESPOND!' appears, then you will need to investigate why the PC and IMP module aren't communicating.

To test the sampling action of the module, unplug the DB25 lead and momentarily short pin 9 of SKT1 to ground. This should trigger the GO flipflops (IC14a and IC14b) into action, causing the sample LED to illuminate as the sample run occurs. The unit will stop at that point however, since the information is then normally read back by the PC via the now disconnected DB25 cable.

If the unit passes this test but still won't communicate with the PC, you can assume that at the very least, either the PC is not pulsing the MS-bit data line at its printer port (pin 9), or there is a fault in that line of the cable.

By the way, you can also manipulate the printer port's data lines with a simple BASIC statement such as 'OUT &H378,0 : OUT &H378,255', where 378 is the port's address (LPT1 in this case), and 0 and 255 are the decimal values of the consecutive bytes sent to the data lines. In practice this just pulls all of the module's control lines low for a brief period, which should trigger a sampling run. To toggle *just* the 'start' control line at pin 9, you would send a value of 127 rather than 0.

We should also point out that some laptop computers don't use standard circuitry to drive their parallel port, and may not work with the IMP module. While this appears to be confined to older Toshiba machines, it may pay to first confirm that a laptop has a truly standard printer port, before it's used with the IMP system.

In circuit terms, it seems that some of

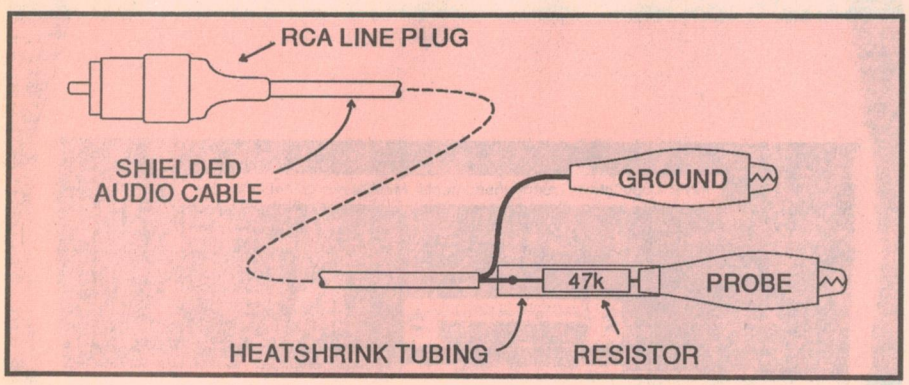
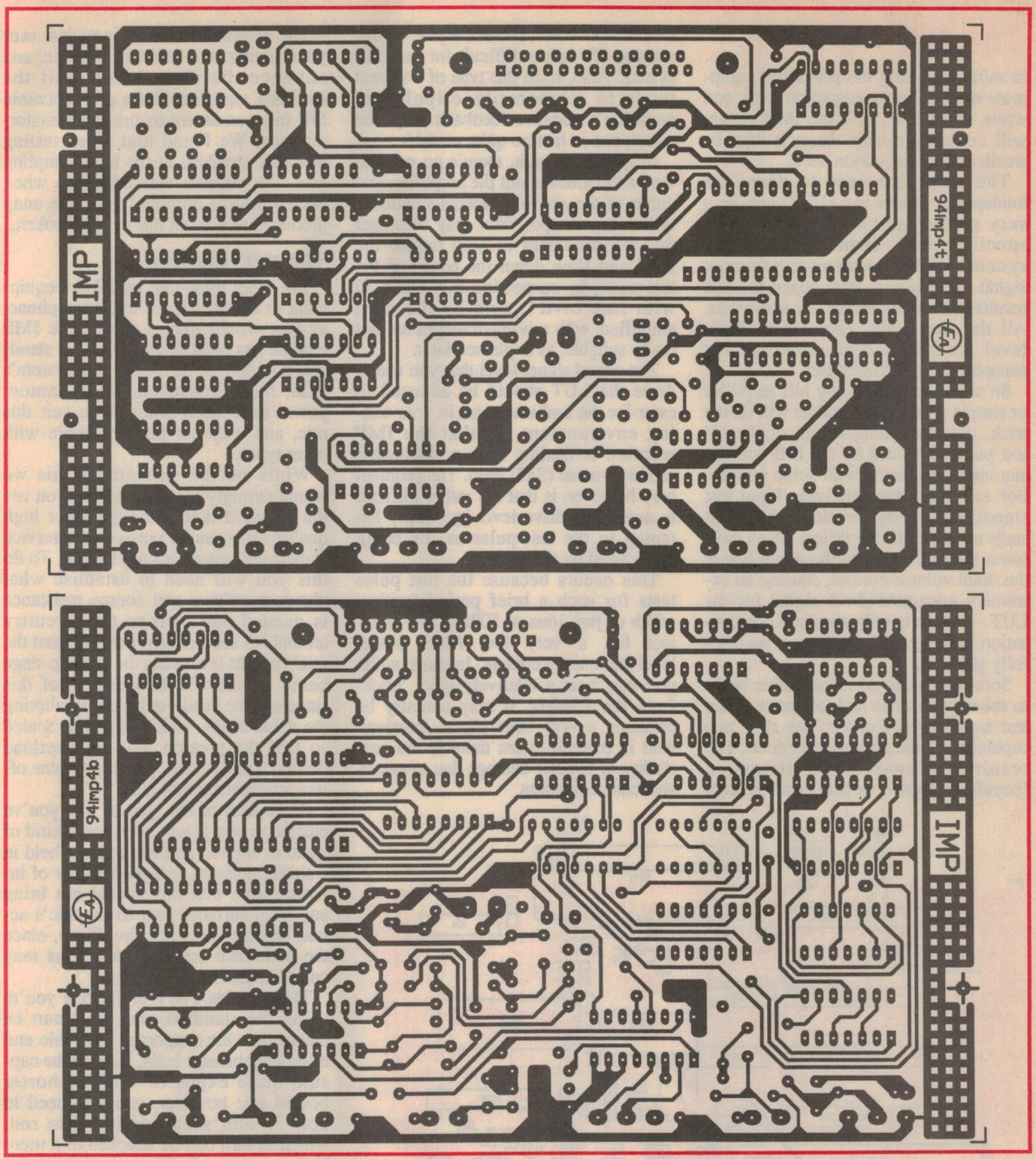


Fig.7: Use this diagram as a guide when constructing IMP's input probes, which bring high level amplifier signals down to a level suitable for the module's input circuitry.



The PCB artwork for IMP's double sided circuit board, shown at actual size for those who wish to fabricate their own. The upper pattern is for the top layer (component side), while the lower pattern is for the PCB's bottom layer.

the port output control lines have insufficient drive current to overcome the IMP module's 1k pullup resistors — apparently, the port's source resistance can be as high as 10k.

While it's unlikely, you may even find that the printer port in a more conventional desktop PC can't source enough current to drive the module's control lines — check that the lines are falling close to 0V. If this is the case try increasing the value of the module's pullup resistors from 1k to say 2.2k (or even higher), and try again. The resistors should be maintained at the lowest possible value however, so as to reduce the effects of noise and interference picked up by the printer cable.

Worthwhile hints

Assuming that all is well with your module and computer though, you can now start using the IMP system in earnest. There are a few points to keep

in mind regarding the peripheral equipment used during loudspeaker tests, and while experience with the IMP system will certainly clarify these, it may be worth a brief discussion here.

The amplifier used to drive the loudspeaker under test (LUT) can be a very modest unit with unimpressive specifications, thanks to the IMP system's ability to monitor its output signal via probe 1, then adjust the test results to compensate for any anomalies. All the amp really needs is an input level control, and an output power capacity of just a few watts.

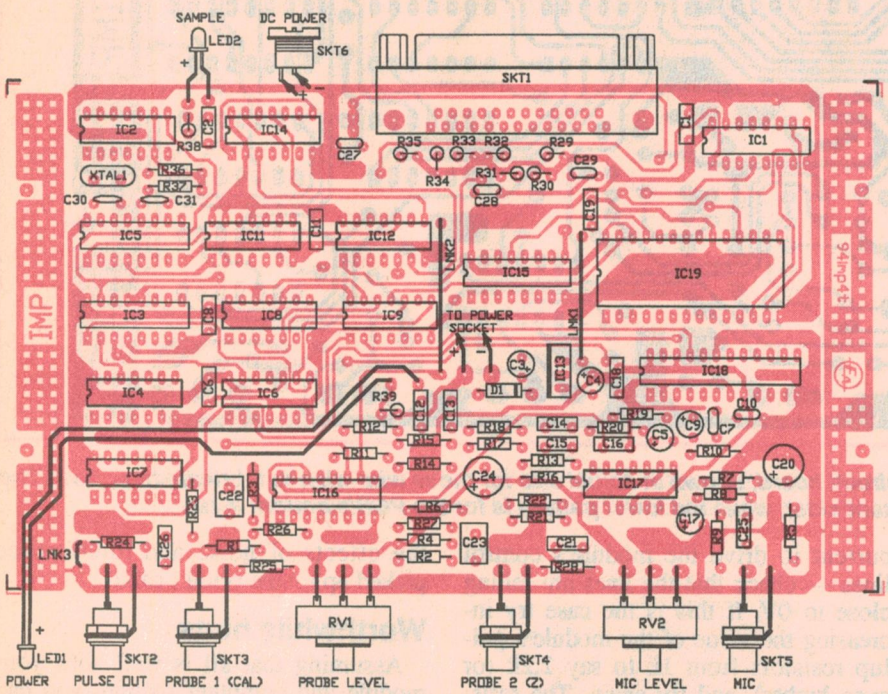
So while just about any hifi amplifier or simple power amp module will do the trick, the demanding nature of the 5V test pulse produced by the IMP module can cause problems with some circuits. For example, this relatively large test signal can easily overload the input stage of those hifi amplifiers which have some kind of active buffer stage *before* the main volume control, causing an extremely corrupted drive signal for the LUT — there is only so much compensation that the IMP system can successfully perform.

Some amps can also react rather badly to the very fast rise and fall times of the test signal, which exceed the slew rate capability of the amplifier's circuit. The resulting slew-induced distortion (popularly known as SID) causes large non-linearities at the output, again making life rather difficult for the IMP system. Also, since this type of overload tends to temporarily cripple the amplifier's negative feedback loop, the circuit can in fact go quite unstable.

In general though, there's no need to worry too much about the amplifier, and either of the above problems should be quite easy to spot. You may then feel that it's necessary to both reduce the level and slow down the edges of the test pulse, by connecting R24 and C26 with link LNK1. And by the way, amplifiers with a *bridged* output are not really suitable, as explained later.

The actual signal level that you use to drive the LUT should be adjusted to cater for the ambient noise in your testing environment, so that the IMP software is dealing with a reasonable signal-to-noise (S/N) ratio. The problem here however, is that it's rather difficult to assess the drive level by simply listening to the test pulse as it's being reproduced by the speaker.

This occurs because the test pulse lasts for such a brief period (with a width of just 16us or 500us), and in effect has a very low RMS power level and energy content. In short, while you may hear a relatively quiet 'click' from the speaker, it may actually be handling a very large signal transient. And in extreme cases there is the possibility of tweeter damage due to excessive cone excursion.



The component overlay diagram for the module's PCB. LNK3 is optional (see text), and the board's top layer has been shown as the location guide.

The answer of course, is to just start your testing at a safe low volume, and advance the drive level until the received signal exhibits a respectable S/N ratio, as shown by the data transformations. We found that when testing domestic speakers at the high sampling rate, the volume was adequate when each impulse sounded like the snap produced as a small dry twig is broken.

The microphone

The other important peripheral equipment to consider is the test microphone, as you would expect. Since the IMP module has been designed with a standard microphone in mind, the system's gain, input impedance and phantom power have been arranged to suit this mic, and may not be compatible with other types.

While on the strength of this we would strongly recommend that you use the standard unit, although other high quality mics can be pressed into service if their characteristics are known. To do this you will need to establish what phantom voltage and source resistance is needed and change the circuitry around R5 accordingly, then test that the mic's output level suits the preamp stage based around IC17b. The gain of this stage can be easily adjusted by altering the value of R9, which should be scaled so that the preamp will not overload during typical tests, yet the system offers an adequate S/N ratio.

Regardless of the type of mic you've elected to use, it will need some kind of stand or support so that it can be held in a steady position near the speaker of interest. Note that this should not bring any solid surfaces near to the mic's actual capsule (or input, in effect), since the additional acoustic reflections may compromise the test results.

This shouldn't be a problem if you're using the standard mic, as it can be clamped to the support at the cable end of its long tubular body, leaving the capsule quite exposed. With a shorter bodied mic however, you will need to hold it with some kind of thin rod, which in turn can be attached to a more bulky support. In fact, a conventional boom-type microphone stand (or a facsimile thereof) would be quite suitable.

Traps for the unwary

Finally, we should pass on a few pitfalls that caught *us* out when we began using the IMP system, so that you can make your own mistakes, rather than just repeating ours...

For a start, the IMP module will *not* communicate correctly with the PC

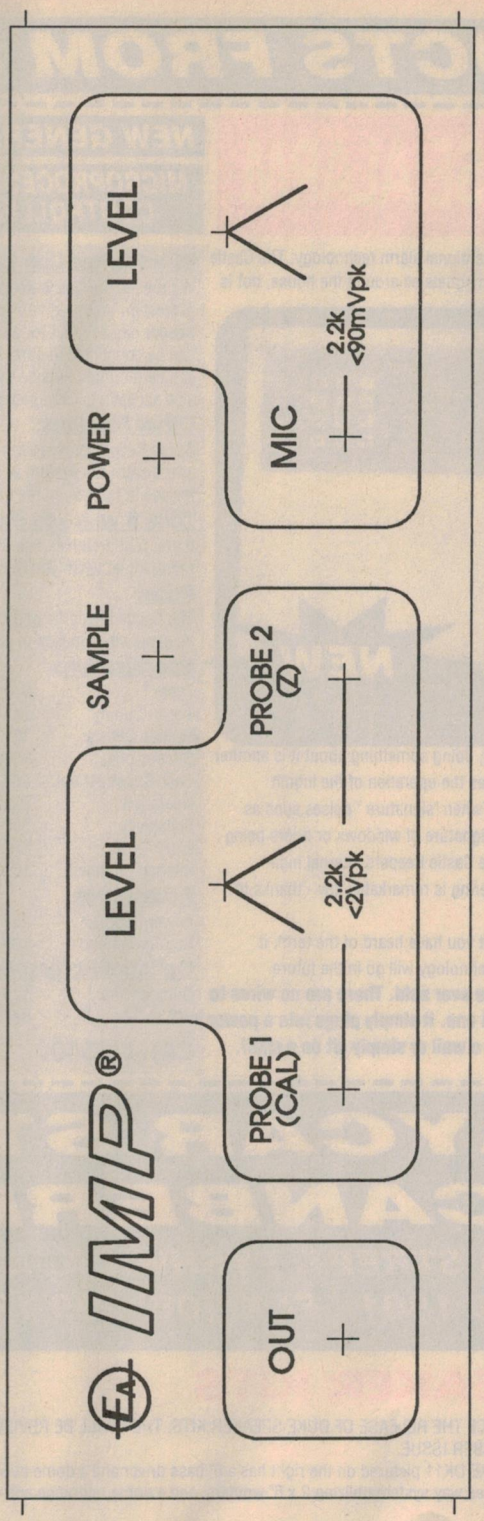
when a software protection 'dongle' is connected to the printer port.

While these devices are supposedly quite 'transparent' to data normally sent to the printer (a debatable point, in any case), the IMP module's data will arrive at the PC in a somewhat garbled form after having passed through the dongle. So disconnect it...

We would also recommend that you note the status of the power LED before commencing an IMP session, as this will confirm that the plugpack is indeed powering the module. The trap here is that the IMP circuitry will operate from the power delivered through the parallel port alone (via the 1k pullup resistors), albeit in a somewhat crippled fashion. In this situation, the module returns unintelligible results to the PC, despite the fact that everything appears to be in order.

When making near-field measurements of (usually) a bass driver, keep the speaker drive signal down to a moderate level, so as to avoid overloading the mic and preamp stage. In this case, the returned trace on the screen may appear to have a sensible shape — despite the fact that it has been seriously clipped in a preceding stage — but the transformed results will not make sense. Keep in mind that the mic preamp stage is *before* the mic level control, so a small trace on the screen doesn't necessarily mean that the preamp is not overloaded.

While the last trap to mention is one that we didn't actually encounter, it's certainly worth keeping in mind as you use the IMP system. This is to double check that the probe lead connections are attached to the amplifier's output with the correct polarity, since the probe's negative clip is ultimately connected to the mains earth via the computer. If you inadvertently reverse these connections, you may damage either the IMP module or the amplifier (by effectively shorting its output) — we've included sacrificial 10 ohm resistors (R25 and R28) on the IMP board, to help protect the amp.



The artwork for the front panel of the module's case, reproduced here full size. The copyright message is intended for the unit's rear panel.

The single-ended nature of the test probe also means that its negative lead would apply a short to one side of a *bridge* amplifier's output, since in that case, both the positive and negative speaker terminals are active (or 'hot' if you like). While there are ways around this problem, your best bet is to use a conventional rather than bridged amplifier for your test setup.

More IMP projects

When time allows, we hope to follow up this series of articles on the basic IMP system with a number of small construction projects for IMP 'accessories', which should make it even more convenient to use. So far, these include an 'MLS' satellite board and a novel 'pulse' amplifier.

MLS is an acronym for Maximum Length Sequence, and refers to an alternative test signal which can be used by the IMP system — provision is already built into an MLS version of the IMP software. Based on pseudorandom noise, the MLS test signal generated by the small satellite board allows the IMP system to effectively perform *4096* sample runs during its brief burst.

Since IMP averages the results of multiple runs in order to reduce unwanted noise, the MLS-based setup will produce a very quiet trace from just one burst of this controlled noise. This technique is also used by the MLSSA system, by the way (hence, the MLS in its name).

The proposed pulse-type amplifier is a very simple circuit which merely increases both the amplitude and drive capability of the IMP's conventional test pulse, thereby eliminating the need for a separate audio amp. As current is only passed to the speaker under test for a very short period, the pulse amp can use stored energy for this task, and therefore draw little power from its DC source — the IMP module's plugpack.

Again, this is will be quite a small board which can be installed inside the IMP module's case. Note that while this amplifier system is convenient for a wide range of applications, it won't suit those who elect to use the MLS test signal, which requires a conventional linear amplifier to drive the test speaker. On the other hand, if there is sufficient interest in a low cost audio amp module that's suitable for the IMP system, we'll take a look at that as well. ❖

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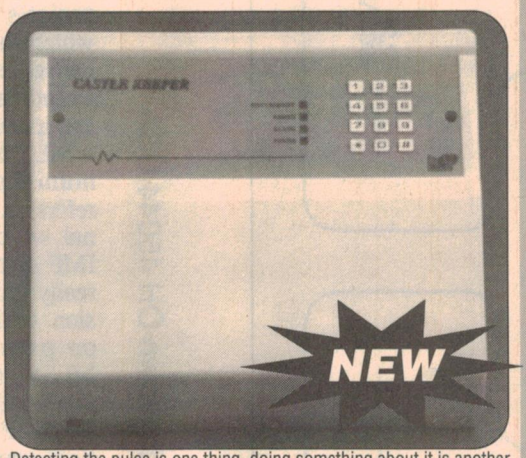

How Does It Work?

When you think about it, you will realise that the amount of air (a mixture of relatively heavy oxygen & nitrogen gases) in all the rooms of your house represents a considerable mass and volume. This volume / mass remains in a fairly static state not withstanding the slow-changing barometric pressure. If a door or window is opened, a small, low frequency - but still significant "pulse" reverberates through the enclosed air mass. The Castle Keeper works by utilizing a unique sensor that detects this pulse. Detecting the pulse is one thing, doing something about it is another. The Castle Keeper has a highly refined computer program that oversees the operation of the inbuilt microprocessor. This "intelligent" program overrides the sensor input when "signature " pulses such as those from air conditioners, pets - even draughts occur. The unique signature of windows or doors being opened is, however recognised and the alarm circuit is tripped and the Castle Keepers internal high powered siren is operated. It works, and it works well, and false triggering is remarkably low - thanks to the very sophisticated computer algorithms.

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What Extras Can be Connected?

We repeat, the Castle Keeper is designed to be a stand alone. For added protection however, you can connect some other devices. Castle Keeper has an input for a passive infra red detector. More than one PIR can be connected in parallel. There is an output for a 12V siren, which can be mounted outside the house in a box if required. The unit will also accept a backup battery inside, in case the power is turned off.

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Castle Keeper is programmable. You can put your own 4 digit code to arm/disarm the system as well as adjustable entry/exit times. Designed for use in houses, home units, flats, even garages, boats and sheds etc.

Take it with you if you move!

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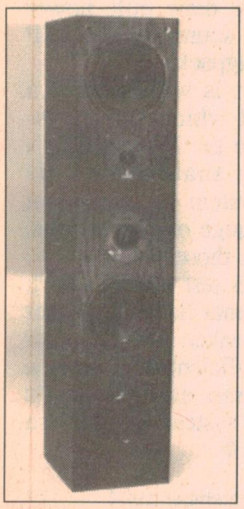

DUKE SPEAKER KITS

SNEAK PREVIEW

JAYCAR ARE PROUD TO ANNOUNCE THE RELEASE OF DUKE SPEAKER KITS. THEY WILL BE REVIEWED IN ELECTRONICS AUSTRALIA - OCTOBER ISSUE.

There are two speaker kits, the DUKE DK11 pictured on the right has a 6" bass driver and a dome tweeter. The larger kit is the DK77 which is a three way system utilizing 2 x 6" woofers, and a dome midrange and dome tweeter.

Full details will be released next month. These speakers will be on demonstration in all Jaycar stores. Please phone for availability.

Brief Specifications:	DK11	DK77
Power handling - RMS:	60W	120W
Sensitivity:	91dB	91dB
Freq Response:	45-20kHz	35-20kHz

NEW

DK77 Kit
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ELECTRONICS SIMPLIFIED CRYSTAL SET CONSTRUCTION

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This book is especially written for those who wish to participate in the intricacies of electronics more through practical construction than by theoretical study. It is designed for all ages upwards from the day when one can read intelligently and handle simple tools. A book highly recommended for all newcomers to the fascinating hobby of electronics.

SOFTCOVER, 71 PAGES, 110 X 178MM. CAT BB-7016, $5.50

LOUDSPEAKERS FOR MUSICIANS

This book contains all that a working musician needs to know about loudspeakers; the different types, how they work, the most suitable for different instruments, for cabaret work, and for vocals. It gives tips on constructing cabinets, wiring up, using wadding, finishing, how to ensure they travel well, how to connect multi speaker errays and more. There is also 10 practical enclosure designs.

NEW

SOFTCOVER, 164 PAGES, 110 X 178MM, CAT. BB-7030, $11.50

HOW TO USE OP AMPS

The operational amplifier is probably the most versatile IC available, and forms the building block for applications from audio to industrial control. This book serves both as a source book of circuits and a referee book for design calculations. It is divided into the following chapters.....meet the op-amp, basic circuits, ocscillators, audio circuits, filters, common op-amps, power supplies, notes and fault finding.

NEW

SOFTCOVER, 154 PAGES, 110X178MM, CAT. BB-7013, $8.95

POWER SUPPLY PROJECTS

This book firstly explains about power supplies and the different types including unregulated, full wave, bridge rectifiers, then discusses rectifier ratings, transformers, fuses, zener diodes, regulators and battery eliminators. The rest of the book has power supply circuits including fixed voltage regulated, variable voltage and miscellaneous circuits. A very handy book indeed.

NEW

SOFTCOVER, 91 PAGES, 110 X 178MM, CAT. BB-7024, $7.50

ACCOUSTIC FEEDBACK - HOW TO AVOID IT

NEW

Feedback is the bane of all PA systems. Many things can be done to reduce it. This book discusses problems with microphones, speakers, the hall itself, the way units are positioned. Electronic aids such as equalizers, frequency shifters and notch filters are looked at. Special requirements for live group concerts are looked at to save you time. A circuit for a twin notch filter is included.

SOFTCOVER, 92 PAGES, 110 X 178MM, CAT. BB-7031, $11.50

ELECTRONIC PROJECTS FOR YOUR PC

PC's internal expansion slots provide full access to the computers' buses and permit a number of add-ons to easily be installed. This book provides a number of useful PC add on circuits including the following....digital in/out ports, A to D convertor, D to A converter, voltage and current measurement circuits, resistance and capacitance meters, temperature measurement interface, model train controllers, position sensors, relay and LED drivers etc.

NEW

SOFTCOVER, 102 PAGES, 110X178MM, CAT BB-7402, $11.50

INTRODUCTION TO AMATEUR RADIO

Amateur radio is a fascinating and unique hobby. This book gives the newcomer a comprehensive and easy to understand guide through the subject. It then remains an essential reference volume to be used time and time again. Topics covered in the book include the basic aspects of the hobby, such as operating procedures, jargon and setting up a station. Technical topics covered include propagation, receivers, transmitters and aerials, etc.

NEW

SOFTCOVER, 150 PAGES, 110X178MM, CAT. BB-7018, $9.95

A BEGINNERS GUIDE TO MIDI

MIDI stands for musical instrument digital interface. With the aid of this book, those with no previous knowledge of MIDI will learn how to....connect up a MIDI system, exploit MIDI modes and channels, understand all about MIDI messages, use MIDI timing and synchronisation facilities, exploit filtering & trans-position, interpret a MIDI imple-mentation chart, avoid problems with MIDI "choke", & just about everything else you need to know to put together a system and use it effectively.

NEW

SOFTCOVER, 102 PAGES, 110 X 178MM, CAT. BB-7401, $13.95

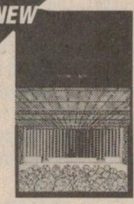
OP AMP USERS HANDBOOK

The first part of this book covers standard op-amp based "building blocks" (integrator, precision rectifier, function generator, amplifiers etc) and considers the ways in which modern devices can be used to give superior performance in each case. The second part describes a number of modern practical circuits, including.....low noise tape and RIAA pre-amps, audio amps, DC controllers, video fader, audio signal generator, audio millivolt meter and more!

NEW

SOFTCOVER, 120 PAGES, 110X178MM CAT. BB-7012, $13.95

PUBLIC ADDRESS LOUDSPEAKER SYSTEMS



If you ever get involved in PA systems, you need this book. The first chapter discusses the moving coil speaker and how it works. It then explains about baffles, PA system requirements, sound patterns, line source speakers, horn speakers, line source ceiling array, low impedance matching, 100V line systems, transmission lines and finally hearing-aid induction loops.

NEW

SOFTCOVER, 114 PAGES, 110X178MM, CAT BB-7033, $11.50

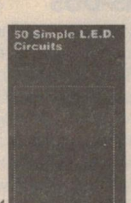
IC 555 PROJECTS

Every so often a device appears that is so useful that one wonders how life went on before it. The 555 timer is such a device. The projects include basic circuits (15), car circuits (9), model railway (4), general (20), noisemakers (11), variations, practical notes and fault finding. An invaluable addition to the library of all those interested in electronics.

NEW

SOFTCOVER, 167 PAGES, 110X178MM, CAT. BB-7011, $8.95

50 SIMPLE LED CIRCUITS

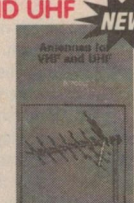


Contains 50 interesting and useful circuits and applications based around the famous led (light emitting diode). Circuits include testers, timers, indicators, displays etc. There is also circuits for the 707 common anode display.

SOFTCOVER, 62 PAGES, 110 X 178MM, CAT. BB-7014, $5.95

NEW

ANTENNAS FOR VHF AND UHF



This book starts by explaining basic theory about aerials and feeders. It describes; types of aerials, those suited for hi fi / scanners / radio amateurs, measurement, advantages of different types, how to get the best results, practical aspects of erecting aerials and how to position them correctly to get the best performance.

NEW

SOFTCOVER, 104 PAGES, 110 X 178MM, CAT. BB-7021, $13.95

MORE BABANI BOOKS

POPULAR ELECTRONIC PROJECTS

Projects included are; MW & SW radios(5), 27MHZ FS meter, radio TX/RX, 2 amplifiers, preamps, noise/rumble/scratch filters, 4 channel mixers, intercom, metal detector, rain alarm, power controller, high imp voltmeter, transistor/ continuity testers, power supply, AF signal generator, flash slave unit and more. 27 projects in all are described.

NEW

SOFTCOVER, 135 PAGES, 110 X 178MM, CAT. BB-7028, $7.50

PRACTICAL ELECTRONIC FILTERS

This book reviews the main types of filter, explaining in simple terms how each type works and how it is used. Chapter headings include: introducing signals and filters, resistors / capacitors & frequency, passive filters, low / high pass active filters, band pass filters, notch and other filters, format filtering, voltage controlled filters, digital filtering and practical filter designs.

NEW

SOFTCOVER, 188 PAGES, 110 X 178MM, CAT. BB-7026, $13.95

PREAMPLIFIER AND FILTER CIRCUITS

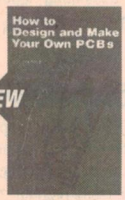
This book provides circuits and background information for a range of preamps, tone controls, filters and mixers etc. Low noise OP AMPS and audio preamp IC's have enabled low cost circuits to have excellent performance. The preamp circuits include; mic cartridges, crystal/ceramic, guitar and tape head. Other circuits include tone controls, filters, mixers and volume controls.

NEW

SOFTCOVER, 92 PAGES, 110 X 178MM, CAT. BB-7027, $11.50

HOW TO DESIGN AND MAKE YOUR OWN PCBS

The emphasis of this book is placed on the practical aspects of PC board design and construction. Chapter 1 deals with simple methods of copying PCB designs from magazines and books. Chapter 2 covers photographic methods of producing PCBs. Chapter 3 deals with most aspects of designing your own PCB layouts.



NEW

SOFTCOVER, 66 PAGES, 110 X 178MM, CAT. BB-7023, $7.50

GETTING THE MOST FROM YOUR MULTIMETER

This book is primarily aimed at beginners, and those with a limited knowledge of electronics. Chapter 1 covers the basics of analogue and digital multimeters. In chapter 2 various methods of component checking are described, including tests for transistors, thyristors, resistors, capacitors and diodes. Circuit testing is covered in chapter 3, where subjects such as voltage, current and continuity checks are discussed.

NEW

SOFTCOVER, 102 PAGES, 110 X 178MM, CAT. BB-7034, $8.95

PRACTICAL ELECTRONIC TIMING

This book outlines the ways in which electronics is applied to the measurement of time. As well as theory, there are projects for the beginner and also the advanced constructor, covering many fields of interest including basic time keeping, laboratory data recording, high precision timing, sports and games, music and others. All the circuits can be powered by battery and use common devices.

NEW

SOFTCOVER, 164 PAGES, 110 X 178MM, CAT. BB-7025, $13.95

COMPUTER BOOKS

PROGRAMMING IN QUICKBASIC

Revised Edition - Published 1994
This book explains; how to use the Quickbasic environment and editor, how to format print statements and use the input / read / data statements, how to control program flow with the "for...next / do / while...when" loops, how to write modular programs, how to use sequential and random access files and more. Companion disc available by mail order from the UK.

NEW

SOFTCOVER, 168 PAGES, 130 X 198MM, CAT. BB-7421, $13.95

DOS - ONE STEP AT A TIME

If you want to know enough about DOS so that you do not panic when confronted with the DOS prompt, want to keep your system running efficiently and keep your programs and data secure, then this book is for you. This book is written for the non-expert, busy person in mind. The book explains; how the DOS system works, how to format a floppy disc, how to manage disc files, how to use the system configuration files etc, etc.

NEW

SOFTCOVER, 83 PAGES, 130 X 198MM, CAT. BB-7427, $11.50

UNDERSTANDING PC SOFTWARE

If your are unfamiliar with the various types of software in common use, this book will help you to understand their basic functions, and how they are used. It then becomes fairly obvious which types are of use to you. The types of software covered include: word processors and spelling checkers, graphics programs - CAD / 3D or CAD /illustration, paint programs / business graphics, desktop publishing, databases, spreadsheets and utilities.

NEW

SOFTCOVER, 131 PAGES, 130 X 198MM, CAT. BB-7423, $13.95

UNDERSTANDING PC SPECIFICATIONS

The main difficulty for the uninitiated when purchasing a computer is deciding on the specification that will best suit his or her needs. This book explains PC specifications in detail, and the subjects covered include; differences between types of PC (XT, AT, 386, 486, etc), maths co-processors, input devices (keyboards, mice etc), memory, RAM, floppy disc drive formats, hard disc drives, display adaptors (CGA, super VGA etc) and more.

NEW

SOFTCOVER, 120 PAGES, 130 X 198MM, CAT. BB-7424, $13.95

LEARNING TO PROGRAM IN C

Chapters 1-3 deal with basic C statements which control program flow & allow the user to manage with most aspects of the language. Chapters 4-5 introduce the concepts of string arrays, numeric arrays & function subprograms which expand the programming capabilities of the user beyond the beginners level. Chapter 6 deals entirely with data-file handling, while chapter 7 deals with unique C structures, both of which should be of interest to all those who need to process large quantities of data. Companion disc available by mail order from the UK.

NEW

SOFTCOVER, 127 PAGES, 130 X 198MM, CAT. BB-7425, $13.95

MAKING MS-DOS WORK FOR YOU

If you use MS-DOS operating system, this book could help you improve your system setup and provide you with a simple to use, but professional looking menu system. The book was written with the "busy" person in mind, and is based on "what you need to know first, appears first". Its also designed to be circular, which means you don't have to start at the beginning and go to the end. Companion disc available mail order from the UK.

NEW

SOFTCOVER, 111 PAGES, 130 X 198MM, CAT. BB-7419, $13.95

A CONCISE INTRODUCTION TO WORDPERFECT 5.2 FOR WINDOWS

This book assumes no previous knowledge is known. The routines described here will help you get the most out of Wordperfect 5.2, and of your computer, in terms of efficiency, productivity and enjoyment. The book explains; the hardware requirements, how to benefit from the built in help system, how to enter, edit and how to start at the beginning and go to the end. Companion disc available mail order from the UK.

NEW

SOFTCOVER, 159 PAGES, 130 X 198MM, CAT. BB-7418, $16.95

A CONCISE INTRODUCTION TO MS-DOS

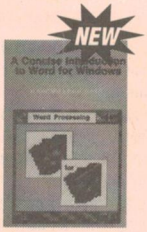
If you want to get the most out of your computer you must learn its MS-DOS operating system. The book explains; how the DOS system is structured, how to use the DOS commands, how to use the EDLIN line editor, directories and sub directories, how to write batch files and more.

NEW

SOFTCOVER, 93 PAGES, 130 X 198MM, CAT. BB-7406, $8.75

A CONCISE INTRODUCTION FOR WORD FOR WINDOWS

This book will help you come to grips with Word for Windows. It explains: hardware requirements, how to benefit from the built in tutorial, how to become familiar with the Word environment, how to enter - edit and enhance text, become comfortable with document page layouts etc including drawing tables and graphing. An excellent book for anyone who wants to get the most out of Word for Windows. Companion disc available mail order from the UK.



NEW

SOFTCOVER, 141 PAGES, 130 X 198MM, CAT. BB-7403, $16.95

MORE NEW BOOKS

ALL ABOUT NICKEL CADMIUM BATTERIES

Nicad batteries are used everywhere these days. This is the first book we have seen that is totally dedicated to the subject.
Chapter 1 discusses their characteristics, construction and important fact and figures. Chapter 2 is devoted to simple charger circuits. Chapter 3 talks about elements of constant current source. Chapter 4 covers 14 basic current sources, which are essentially circuit blocks for designing chargers. Chapter 5 describes 41 different charger circuits. Chapter 6 discusses fast chargers. Chapter 7 provides guidance for charging and upkeep of nicads. Chapter 8 has more kits and chapter 9 shows how to convert battery eliminators to nicad chargers.

SOFTCOVER, 308 PAGES, 180 X 235MM,

CAT. BM-2485 **$22.95** NEW

MODERN SATELLITE AND CABLE TV MANUAL

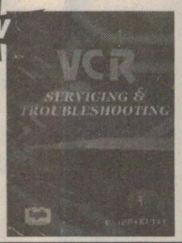
NEW

If you wish to increase your general knowledge of satellite TV this book will help. Whilst it is written basically for the Indian market, it still gives the reader a good overview of the subject. It talks about satellites, C-band satellite reception, dish receiving antenna, feedhorns, LNB, cables, amplifiers, receivers, modulators, equalizers, filters, cable TV, testing equipment, scrambling and descrambling, interference, fibre optics, Intelsat earth Station, equations & charts, faults and their rectifying.SOFTCOVER, 176 PAGES, 220 X 270MM,

CAT. BM-2486 **$22.95**

VCR SERVICING AND TROUBLESHOOTING

NEW



If you like the idea of taking the lid off a VCR and having a dabble, and need a book to give you some help, then this is the book. It explains how a VCR works, and gives clues on electrical and mechanical adjustments and troubleshooting.

SOFTCOVER, 106 PAGES, 230 X 178MM,

CAT. BM-2487 **$17.95**

MULTITURN POTS

We've made a scoop purchase of a range of Japanese made Sakae brand multiturn pots. These are top quality, and normally sell for around $14. These are 10 turn, glass filled with phenolic base. Stainless steel 1/4" shaft with screwdriver slot. Linear tracks rated at 3W @ 40 degrees celcius. Some values are in small quantities.

VALUE	CAT NO:				
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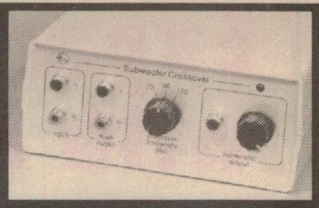


ACTIVE CROSSOVER FOR SUBWOOFERS REFER EA SEPT 1994

Incorporate a subwoofer into your existing system with this crossover. It features 3 selectable crossover frequencies (70Hz, 90Hz or 120Hz), and high-pass outputs for the main amplifier, and an adjustable mono low-pass output for the subwoofer amp. The Jaycar kit includes case, punched and screened front panel, PC boards, transformer, all hardware and specified components.

CAT. KA-1764 **$69.95**

NEW TOOLS FROM JAYCAR

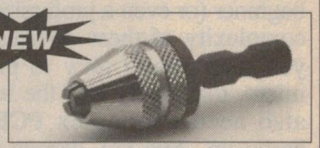
MAGNETIC T BAR SCREWDRIVER SET

NEW

This handy kit incorporates a T bar screwdriver with cushion grip for extra torque. It has a powerful magnetic chuck which accepts any of the metric bits. There are 11 bits included in the pack - Philips No 1, 2 or 3. Slotted No 3, 4, 5, 6 and 8 / Torx No T15, T20 and T30. An ideal tool set for any tool box, glove box, kitchen cupboard etc.

CAT. TD-2022 **only $5.95**

PC DRILL CHUCK



NEW

This amazing chuck will allow you to use mini drills from 0.6mm up on your normal drill / cordless drill / power screwdriver or screwdriver which accepts standard hex bits. WHAT A GREAT PRODUCT!!!

CAT. TD-2010 **only $6.95**

BRAVO SCREW DRIVER SET

NEW

This pocket screwdriver set consists of 6 bits in a plastic case. The case becomes the handle of the screwdriver, and it works surprisingly well. The bits included are 3 Philips Nos 1, 2 & 3 - Slotted 4mm, 6mm & 7mm. An ideal emergency screwdriver set for the car, home, boat, toolbox etc. Note: Unit supplied is all black. Size: 80 x 50 x 12mm. Case also has belt clip.

CAT. TD-2020 **only $4.95**

TOOL MAGNETIZER / DEMAGNETIZER

NEW

We've found a new supplier and been able to reduce the price. You can magnetize all your screwdrivers with this tool in seconds.

TD-2042
was $9.95
now $4.95
save 50%

BUY 10 LESS 10%

1.2A 6V SLA BATTERY BARGAIN

NEW

We've made a scoop purchase of some 1.2AH 6 volt Sealed Lead Acid Batteries. Save a fortune over normal prices. Size: 97(L) x 24(W) x 53(H)mm including terminals.

Cat. SB-2493 **ONLY $7.95ea**

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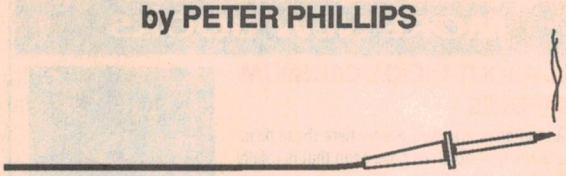
Experimenting with Electronics

by PETER PHILLIPS



The Number Cruncher

Here's a simple but useful experimenter's project based around a Motorola microcontroller. If you are interested in learning about or experimenting with these amazing ICs, this will get you started.

These days it's virtually impossible to ignore the presence of the microprocessor, or its cousin the microcontroller. The difficulty for a beginner (or even a professional) is the complexity of these devices. Even if you understand how to program a micro, that's only half the battle. You also need a complex PCB for the hardware. And yet, despite these difficulties, the microprocessor and its derivatives have become a part of nearly every appliance and device we use. So we really can't ignore this type of technology in this column.

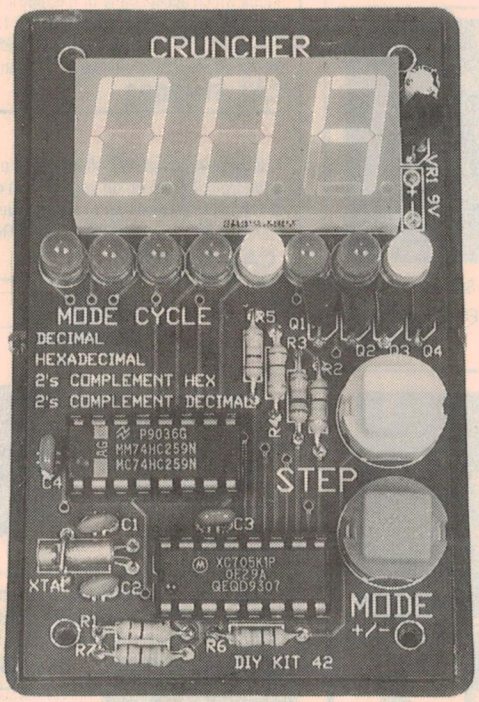
The problem is, it takes more than this column to explain how a microprocessor works. The secret to learning about these devices is to work with them, which is what the project we're describing lets you do.

The project, called the Cruncher, comes from DIY Electronics, and uses a 68705K1 microcontroller IC to show conversions between decimal numbers and binary, hexadecimal, two's complement, and so on. How will that help you learn? Because the program inside the 68705 is also supplied on disk, for you to analyse. It's fully annotated and even includes flow charts.

The documentation supplied with the package includes a printout of the flow charts, and a description of the routines within the program. In other words, here's a small, useful microcontroller-based device with everything you need to let you really 'get inside' the circuit, and to understand exactly how it works.

I'll attempt to fill in some of the blanks, although you should also get a copy of the Motorola technical data manual on the MC68HC705K1 microcontroller. See the end of the article for suggestions on where to get this manual.

Now for some background information about microprocessors and microcontrollers...



The microprocessor

A microprocessor is a complex integrated circuit able to perform a repertoire of digital operations, like adding two numbers, moving digital information from one storage point to another and so on. An operation is done when the microprocessor receives the binary code 'instruction' that represents the operation. Because each microprocessor operation is very basic, quite a few instructions are needed to achieve a useful function. A group of microprocessor instructions is called a *program*.

For instance, to make a microprocessor multiply two numbers might need a program containing over 100 instructions. These would include operations to load the numbers being multiplied into the microprocessor, then a sequence of instructions, called an *algorithm*, to actually perform the multiplication.

A program is usually broken into *routines*, which are blocks of operations that perform a function within the program.

A routine is usually developed and tested separately, before being integrated within the program, and sometimes the same routine is used several times in the program. In other words, a program can often be put together quite quickly if you have a lot of microprocessor routines already developed and tested. Sometimes you might use routines developed by other people, particularly the 'bread and butter' ones, such as a routine to read a keyboard or to operate a display.

While microprocessors are all different in some way, they all have the following:

1. An arithmetic/logic unit , which performs arithmetic operations (such as addition and subtraction) and logic operations (such as testing a value to see if it's a logic 1 or 0).
2. Temporary storage locations, called registers, which hold data, instructions, or the results of calculations;
3. The control section, which times and regulates all elements of the system and also translates binary codes into activities (such as instructions to add, move, or compare data); and
4. An internal bus, which is a network of communication lines that links internal elements with each other, and provides a link to devices outside the microprocessor.

A microprocessor on its own is almost useless, and generally forms part of a system like that in Fig.1. The essential parts are *memory*, usually consisting of read only memory (ROM) and random access memory (RAM), and *input/output ports*. The blocks are interconnected with three buses: the address bus, which selects the required memory location or I/O port; the data bus, which transfers the data

between the blocks; and the control bus, which enables or disables the memory or I/O ports, as required by the microprocessor.

The ROM holds the program to operate the microprocessor, especially when power is first switched on. ROM is designed to retain its contents when the power is turned off. On the other hand, RAM memory loses its contents at power-off, but unlike ROM, can be used to store temporary data, where the microprocessor *writes* the data to the memory.

The input and output ports connect the system to devices like a keyboard, LEDs, switches and other 'real-world' devices. Timing pulses for the system are produced by a crystal controlled oscillator, called the clock.

The microcontroller

A microcontroller contains all the blocks of Fig.1, in the one IC. That's right — it's a microprocessor with its own ROM, RAM and input/output (I/O) ports. Because of the physical limitations imposed by the IC package, the amount of memory and the number of I/O ports is generally limited.

The main advantage of a micro-controller over a discrete microprocessor system is that all the data and address buses, address decoding, control logic, memory and I/O ports are inside the IC. This gives a smaller and less complex circuit board with a lower chip count, and lower cost.

There are many types of microcontrollers. Two popular families are the Intel MCS-48 family and the Motorola 68705 series. Here we are interested in the latter...

68705 microcontrollers

All members of the 68705 microcomputer family are designed around a common core consisting of a CPU (microprocessor), timer, oscillator, ROM, EPROM (erasable programmable read only memory), RAM, the control section and bi-directional I/O lines. As well, each version within the family has a combination of options unique to that version. These include different capacity EPROM and RAM, various numbers of I/O lines and external interrupt lines. Some versions also have an A/D converter or a serial interface.

The 6805K1

The 'K1 is an 8-bit device and its 16-pin DIP package is the smallest package for any 8-bit microcontroller. The block diagram of the device is shown in Fig.2. This diagram is from the Motorola HC05 data book and is therefore very detailed.

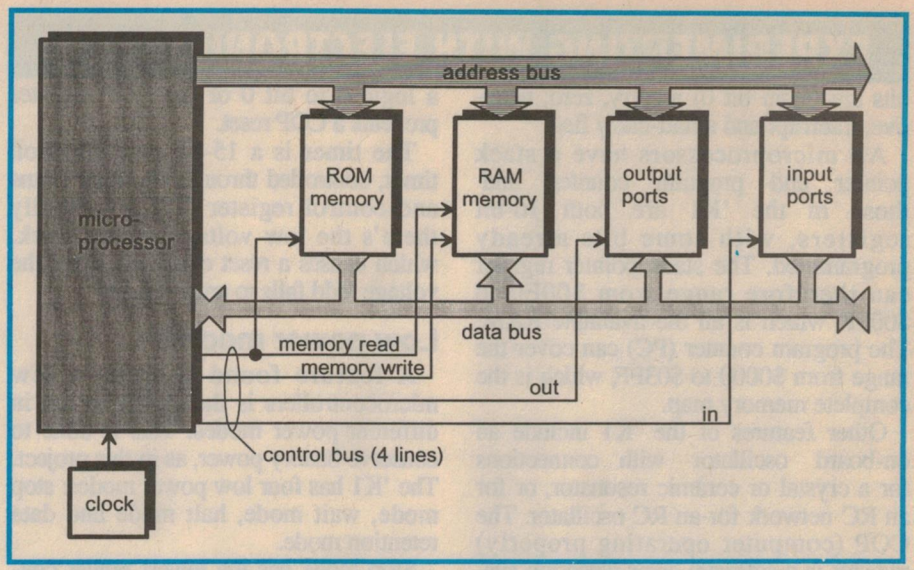


Fig.1: The block diagram of a microprocessor based system. The block diagram of a computer is much the same.

The memory blocks are at the top of the diagram, starting with 504 bytes of EPROM or OTPROM (one-time programmable ROM). The contents of an EPROM can be erased with ultraviolet light, and a microcontroller with EPROM has a quartz window in the top of the package. It is therefore more expensive than the OTPROM version, but it can be reprogrammed many times, unlike the once-only OTPROM version.

There is one byte reserved for the EPROM mask option register (MOR). This location is an 8-bit register used to enable or disable various functions within the IC. The personality EPROM (PEPROM) is a 64-bit section of the EPROM that requires special programming. The 32 bytes of RAM can be used for temporary data storage, and is also the stack register.

There are two I/O ports, port A and port B. The data direction registers (DDR) associated with these ports determine whether each terminal of either I/O port is an input or an output. You can therefore have one terminal of, say port A set as an input, and the rest as outputs.

The I/O ports and their DDR's are accessed as if they are a memory location. This means they are included in the memory map, as shown in Fig.3. There are 13 registers in the memory map, with port A at address $0000 ($ = hexadecimal).

The RAM starts at address $00E0, extending to $00FF. An unused range of 256 memory locations starts at $0100, and the user EPROM starts at $0200.

The microprocessor part of the 'K1 is relatively basic, containing an 8-bit accumulator, a condition code register (CCR) and an 8-bit index (X) register. The X register can be a general-purpose storage register or used with indexed addressing, (a type of addressing where the index register contents form part of the address being accessed).

The CCR is a 5-bit flag register that shows the results of an operation. Each bit (flag) can be tested, and action initiated as a result. As shown in Fig.1, the

PARTS LIST

Resistors

All 1/4W, 5%
R1-R7 10k

Capacitors

C1,2 27pF ceramic
C3,4 100nF, monolithic
C5 10uF 16V electrolytic

Semiconductors

Q1-Q4 BC547 NPN transistor
IC1 preprogrammed 68705K1 microcontroller
IC2 74HC259 3 to 8-line demultiplexer
VR1 LM2936 5V regulator
L1-L8 5mm red LEDs
LD1 CM3-565X 3-digit common cathode display

Miscellaneous

Double-sided PCB coded DIY KIT 42, 78 x 49mm; 2 x normally-open PCB mount pushbuttons; 9V battery and battery clip; 4.096MHz quartz crystal; plastic case, 53 x 82 x 28mm with screws; 2 x 16-pin IC sockets.

A kit containing all the components and documentation for this project is available from Alpine Technologies, PO Box 934, Mt. Waverley, Victoria 3149. Phone/fax (03) 751 1989. The price is $45.90, postage included. Payment may be by Mastercard, Bankcard, cheque or money order.

Kits will be sent by airmail from Hong Kong. This is included in the purchase price. However import and other duties which may apply are payable by the purchaser; they are not included in the purchase price.

bits are (from bit 0) a carry, zero, negative, interrupt and a half-carry flag.

All microprocessors have a stack pointer and program counter, and those in the 'K1 are both 16-bit registers, with some bits already programmed. The stack pointer register can therefore range from $00E0 to $00FF, which is all the available RAM. The program counter (PC) can cover the range from $0000 to $03FF, which is the complete memory map.

Other features of the 'K1 include an on-board oscillator with connections for a crystal or ceramic resonator, or for an RC network for an RC oscillator. The COP (computer operating properly) register is a software error detection system that automatically times out and resets the processor if not cleared periodically by a program sequence. Writing a logic 0 to bit 0 of the COP register prevents a COP reset.

The timer is a 15-bit multifunction timer, controlled through the timer status and control register (TSCR). Finally there's the low voltage detect block, which causes a reset condition when the voltage Vdd falls to around 3.5V.

Low power modes

A feature found in quite a few microcontrollers is the ability to run in different power modes. This is done to conserve battery power, as in this project. The 'K1 has four low power modes: stop mode, wait mode, halt mode and data retention mode.

Stop mode has the lowest power consumption and is invoked if bit 5 in the MOR is programmed to a logic zero and a STOP instruction is received. In stop mode, the internal oscillator and the COP watchdog register are turned off. An external signal (interrupt or reset) is needed to bring the chip out of stop mode.

Wait mode is entered when the WAIT instruction is encountered. This mode takes medium power consumption from the supply. An interrupt, reset, COP reset or timer interrupt can bring the 'K1 out of wait mode.

Halt mode is similar to the wait mode, except it can take up to 4064 internal clock cycles to exit. In the data retention mode, the 'K1 retains RAM contents and CPU register contents at a Vdd voltage as low as 2V DC. This mode lets the device remain in a low power consumption state during which it retains data, but the CPU cannot execute instructions. To enter this mode, you hold the reset pin low and lower the Vdd voltage. To exit, return Vdd to normal and return the reset pin to a logic 1.

This description of the 'K1 is necessarily brief, and if you intend programming one of these devices, or want to know more about it, obtain the Motorola Technical Data manual for the IC. Now that we've covered the basics of the 'K1, let's turn our attention to the project.

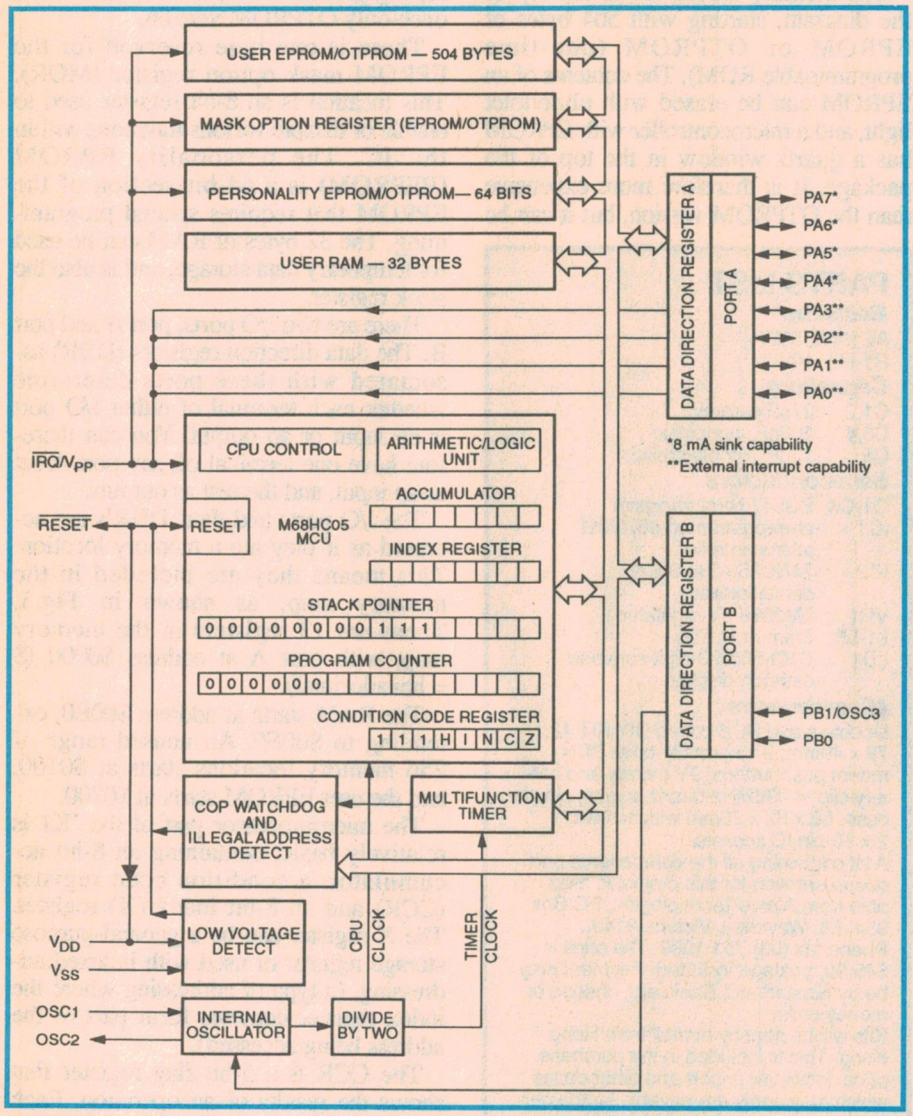


Fig.2: The block diagram of the MC68HC705K1 microcontroller. (Courtesy of Motorola.)

The circuit

As you would expect, the heart of the circuit is the 68705K1P microcontroller IC1. The 'P' means the IC is an OTPROM version and is supplied in the kit already programmed. The remaining sections of the circuit are the power supply, oscillator and I/O components.

There is no on-off switch to the circuit, as the current drain from the battery is around 25uA when the microcontroller switches off, and 30mA when the circuit is running. The LM2936 voltage regulator is an ultra-low quiescent current 5V regulator made by National Semiconductor, and supplies 5V to the circuit from a 9V battery.

The oscillator includes a 4.096MHz crystal, loaded by capacitors C1 and C2. Successive division by two in the 15-bit multifunction timer in the 'K1 generates a 0.50 millisecond TOF interrupt. This means the timer overflow flag (TOF) is set when the first eight stages of the timer counter rollover from $FF to $00. This is converted to an interrupt request if bit 5 (TOIE) of the timer status and control register (TSCR) is set to a 1.

The 'K1 controls the display through port A, lines PA0 to PA7 and port B, line PB0. The hex/decimal information is converted to 7-segment data by the software in the 'K1. The display is multiplexed with transistors Q1 to Q3 and IC2, type 74HC259.

Multiplexing means each display in the three-digit display is turned on for a short period to show its value. Then the next digit is turned on, while the others are switched off. Because the switching is so fast, all displays appear to be on together.

A display in the 3-digit readout will light up only when its driver transistor (Q1 to Q3) is on, operated by outputs PA4-PA6. The digital data for the selected digit in the display appears on the outputs of IC2 (Q0 to Q7). To make the display show the value '123' requires this sequence:

The data for numeral '3' is sent serially to IC2 via PA3, and is stored in the eight internal latches of the IC. This data is already converted to seven-segment format by the program. To store the data, the select inputs S0-S3 are sequenced from 000 to 111 while the data is being sent to pin 13 of IC2. When the data is stored in IC2, pin 14 of IC2 (G) is brought low by output PB0 and the data appears at the outputs of IC2. Transistor Q3 is now turned on, allowing the least significant digit to show the numeral '3'. The other two displays are blank, as they are switched off.

Next comes a similar sequence for the middle display, which will show the numeral '2'. Again the seven-segment code for '2' is fed into IC2, but now transistor Q2 is switched on, allowing the centre display to operate.

Finally, the code for numeral '1' is loaded into IC2 and transistor Q1 is switched on. This sequence repeats over and over, and you see a steady '123' on the displays. Obviously the micro-controller is doing a lot of work to make this happen!

But it gets even more complicated, when you consider the eight LEDs showing the binary value. For example, if the seven-segment display is showing 002, the LEDs should be showing the binary code 0000 0010. That is, only the second least significant LED should be on. Therefore, the microcontroller has to multiplex the LEDs *as well as* the display. So at regular intervals, the code to light the LEDs appears at the outputs of IC2 while Q4 is switched on. When this happens, the displays are turned off by turning off Q1-3. You can see that the microcontroller is doing quite a lot of work to simply drive the displays, let alone perform the mathematics to do the actual number conversion. Try doing this with discrete components!

The forward current in each display segment and LED is limited to around 30mA, because they are being rapidly switched on and off. Therefore, current limiting resistors are not needed. In any case, the peak output current of the LM2936 at 9V is less than 120mA, which is less than the 200mA rating of the displays.

The two pushbuttons connect directly to the microcontroller. Pushbutton 1 (the STEP button) connects to an interrupt input and S2 (MODE) to port B, line 1. An interrupt is an input to the microcontroller that, when activated or 'asserted', causes the program to stop its normal sequence and to go instead to a routine that 'services' the interrupt. The STEP key is used to bring the 'K1 out of stop mode.

Getting going

Now that we've explained the circuit and briefly looked at the 68705K1 microcontroller, the rest is really up to you. I'm not going to explain how to build the kit, or describe the program that controls the device, as all of this is included with the kit.

So, start by building the 'Cruncher'. It's simple to build and all you'll need is a reasonably fine soldering iron. A 9V battery is also required. Then when the device is working, become familiar with what it will do.

Next, read through the supplied explanation of the program, but do it a section (routine) at a time. The Motorola data book includes a summary of the instruction set of the microcontroller, which you will need if you don't know anything about Motorola instruction mmemonics. Eventually you should be able to decipher what the programmer has done, and understand exactly what the circuit is doing. When this happens, you will probably start to see other possibilities.

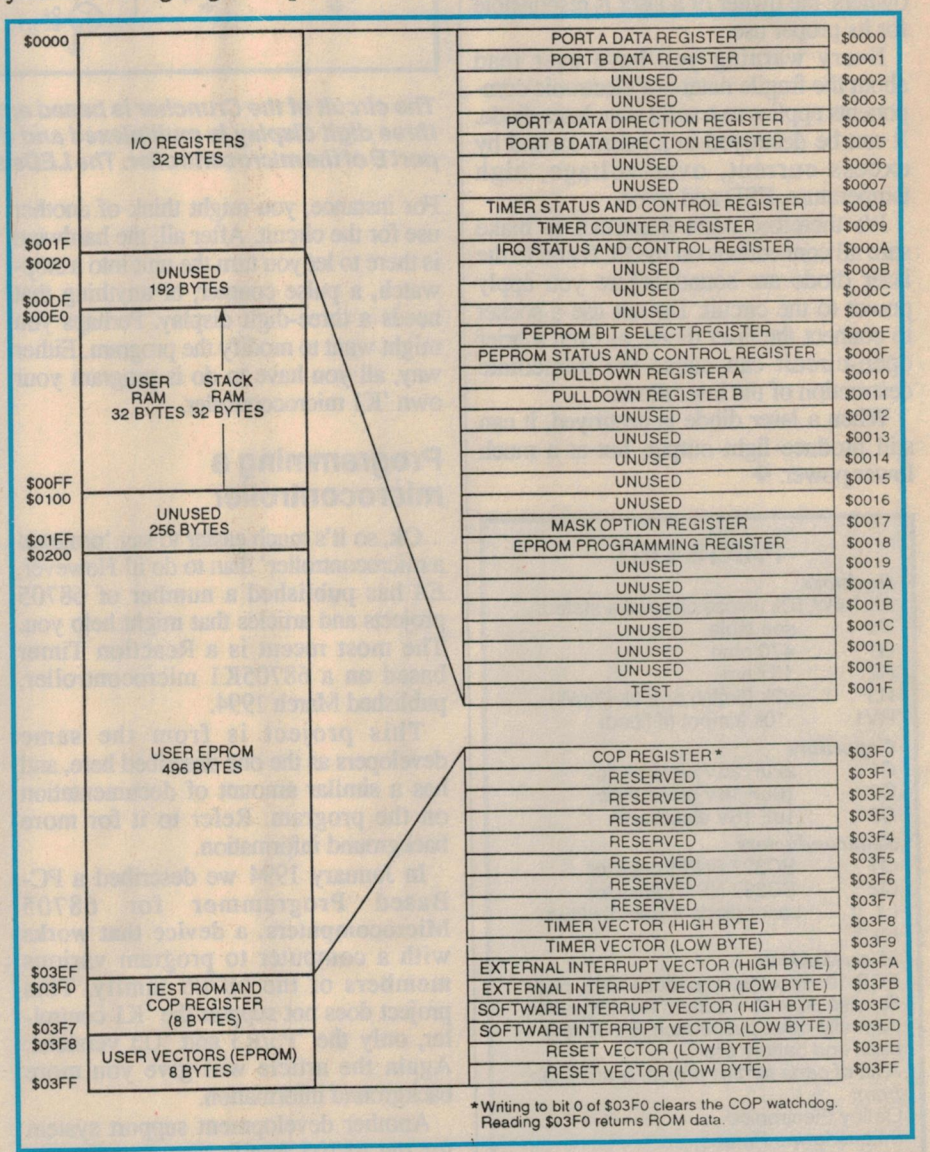


Fig.3: This is the memory map of the 'K1 microcontroller. The addressing range covers 1K (1024) bytes, but not all of this space is available for use. (Courtesy of Motorola).

5mW laser

Continued from page 57

If you have a laser power meter, you can fit a potentiometer to the PCB and CAREFULLY adjust the laser diode current to increase the laser power to its rated 5mW. (Or 3mW for the 3mW version.)

Finally, although we've tried to make sure you are aware of the need to be careful with this project, it has been built by many people and has been tested extensively. When built and commissioned as explained here, there is no reason for the circuit not to work.

Warnings

This device is a class 3A laser and you should attach a warning label to the case. Labels will be supplied by Oatley Electronics. Remember that, like gun owners, the owner of a laser is responsible for its proper use.

Every warning you have ever read about the fragile nature of electronic components applies to a solid state laser diode. It can be destroyed in a micro-second by excess current, over voltage, high temperature, ESD and so on.

It's therefore most important to make sure all connections on the PCB and to the laser diode are sound before you apply power to the circuit. Do not use a socket to connect the laser diode, as even a brief open-circuit can cause the immediate destruction of the laser diode.

When a laser diode is destroyed, it can still produce light output, but at a much lower power. ❖

PARTS LIST

Resistors
All 1/4W, 5% unless otherwise stated:

Rx	see table
R1	470 ohm
R2	15 ohm
R3	22k (5mW) or 2.2k (3mW)
RV1	10k trimpot (if fitted)

Capacitors

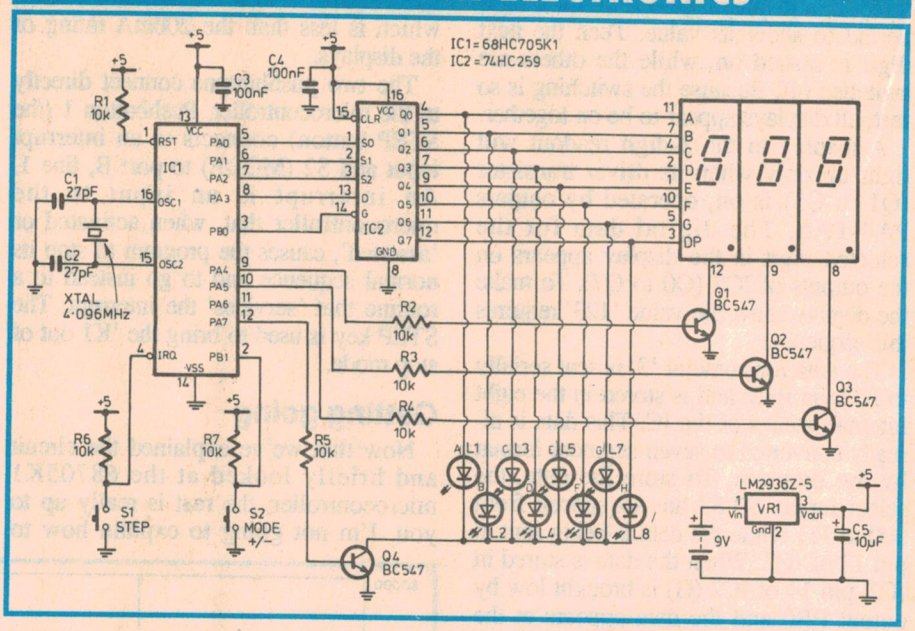
C1	22uF 25V electrolytic
C2	10uF 16V electrolytic
C3	1uF 16V electrolytic

Semiconductors

Q1	BC327 PNP transistor
Q2	BC337 NPN transistor
L1	Laser diode assembly (see text)

Miscellaneous
PCB 19mm x 23mm coded OE92; plastic case 30 x 50 x 80mm; warning label; normally-open pushbutton; 6V battery pack and battery clip;
A kit of parts for this project is available from:
Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):

EXPERIMENTING WITH ELECTRONICS



The circuit of the Cruncher is based around IC1, a 68705K1 microcontroller. The three digit display is multiplexed and driven by output port A and one output of port B of the microcontroller. The LEDs show the binary value of the display value.

For instance, you might think of another use for the circuit. After all, the hardware is there to let you turn the unit into a stopwatch, a pulse counter, or anything that needs a three-digit display. Perhaps you might want to modify the program. Either way, all you have to do is program your own 'K1 microcontroller.

Programming a microcontroller

Ok, so it's much easier to say 'program a microcontroller' than to do it! However, *EA* has published a number of 68705 projects and articles that might help you. The most recent is a Reaction Timer based on a 68705K1 microcontroller, published March 1994.

This project is from the same developers as the one described here, and has a similar amount of documentation on the program. Refer to it for more background information.

In January 1994 we described a PC-Based Programmer for 68705 Microcomputers, a device that works with a computer to program various members of the 68705 family. This project does not support the 'K1 controller, only the 'P3/R3 and 'U3 versions. Again the article will give you more background information.

Another development support system for the 68705 family was described in March 1993. Called a PC-based 68705 Development System, this project includes software to emulate the 68705 program on an IBM type computer. Again it doesn't support the K1 microcontroller, only the P3/R3 and U3 controllers, but it's useful for more background information.

Other projects based on the 68705 include a 68705 Microcomputer system described in September '93, a timer in December '93 and an Electronic Christmas Tree in December '92.

I have also since reviewed a 68705 development system that *does* support the K1 (see the July 1994 issue). This system lets you program a wide range of 68705 microcontrollers, and has an excellent computer-based simulator so you can test and debug the K1 program on a computer. Once debugged, you can then program the K1 using the programmer board that comes with the system. For further information about this system (which costs around $280), contact Oztechnics on (02) 541 0734.

Of course you can build your own programmer, as described in the Motorola data book on the K1 controller. You'll also need the programming software and a Motorola cross-assembler. These programs can be found on some computer bulletin boards. Motorola data manuals are available from Oztechnics, Veltek on (03) 808 7511, and other distributors.

So now it's over to you. Although 'getting into' micros might seem a bit expensive and complicated, you will be learning about, and experimenting with, the most versatile electronic component ever made. ❖

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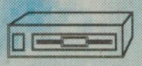

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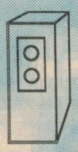

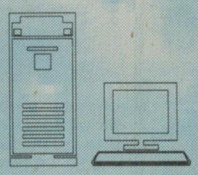

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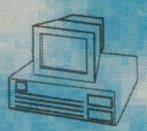

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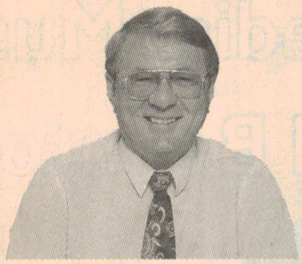

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Regards Jack O'Donnell

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(See EA Dec '89) One mono module - no power supply or case. Fantastic for use in stage amps, Juke boxes, amplifier racks (multi-amplifier setups) discos etc. Requires ±69V DC power supply.

Specifications:
Output Power:.....140W RMS into 8Ω
200W RMS into 4Ω
Power Supply:.....±69V DC
Distortion:.....0.007% @ 140W

K 5170 **$85.00**

FM Stereo Transmitter Kit

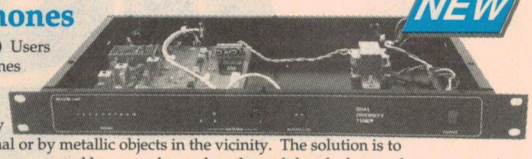
Turn Your CD Player Into a Mini FM Transmitter!

(See SC Oct '88) Simply connect your CD player or any other line level source to the mini transmitter which converts the audio signal to an FM signal. This FM signal can then be tuned in via any FM radio. Great for listening to your favourite CD while washing the car, mowing the lawn or doing the vacuuming etc, without blasting the neighbours.

K 1120 **$34.95**

Dual Diversity Tuner Kit for FM Microphones

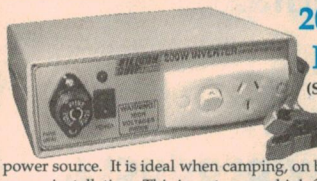
NEW



(See SC Aug '94) Users of FM Microphones are familiar with signal dropout caused by a body blocking the signal or by metallic objects in the vicinity. The solution is to have two receivers separated by several wavelengths and then lock onto the strongest signal, hence dual diversity. This kit features low distortion, high sensitivity, excellent signal to noise ratio, test switch, AGC, Automatic muting and has a range of up to 60 metres. Housed in a sturdy rack mount case. Operates on the standard FM band 88 to 108Mhz. N.B. microphone transmitter not included.

K 1110 **$179.95**

200W Switch Mode Inverter Kit



(See SC Feb '94) This compact 200W Inverter can drive many mains power appliances including power tools, fluorescent and incandescent lights, TV's etc, using a 12V power source. It is ideal when camping, on building sites, on farms or as part of a solar power installation. This inverter, uses high frequency switching techniques which eliminates the need for bulky, heavy transformers enabling a very light weight compact unit.

Features: • Small physical size • Very low standby current • Modified square wave output • Peak-peak voltage equal to mains sine wave • Low battery voltage shutdown • 30A - over current limiting • Fuse protection • Fully isolated output for safety • 2kg mass

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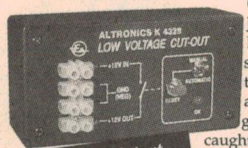
Includes LCD Digital Display for Precise Measurement!

(See SC Jan/Feb '94) This 1.23 V to 40 V adjustable power supply is designed for heavy-duty work. It uses a high efficiency switching regulator circuit. Features preset voltage and current limiting, full overload protection (with indicators) and an LCD panel meter for precise voltage and current readouts. Includes pre-punched front and rear panels. Professionally screen printed front panel, all housed in a sturdy instrument case.

K 3330 **$239.95**

Low Voltage Cut-Out for Cars and Boats Kit



Adjustable Cutout Variable from 10.9V to 11.9V. Includes Automatic or Manual Voltage Reset Function.

(See SC Jan '92) Build this simple little device, and avoid getting caught out with a flat battery during your holidays. It simply connects into a 12V accessories power line, and shuts off the flow if the battery voltage drops to a dangerously low level. Ideal for battery powered camping fridges etc.

K 4328 **$24.95**

High Efficiency Fluoro Inverter Kit

(See SC Nov '93) Great for camping or working on the car at night. This nifty circuit will drive a standard 40 Watt fluoro tube from a 12 volt source. Fluoro lights, are miles more efficient than incandescent globes. Features flicker free starting/running, reverse polarity protection and faulty tube protection circuitry. Globe and housing not included. Requires 11 to 14V DC power source. Suitable for 18, 20 36 and 40W globes. Fuse protected for reverse polarity or faulty tube. Low EMF radiation.

K 6370 **$49.95**

Simple Driver Kit For Servo Motors

Two Versions Supplied!

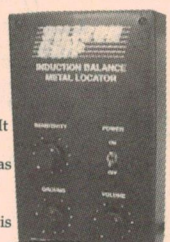
NEW

(See SC May '94) If you have ever wanted to experiment with servo motors but not known where to start, then this kit is for you. Servo motors are used in remote controlled cars, planes, remote mirrors etc. The article explains servos and how they are driven. The kit can be used to either test or direct control servos where a radio link is not required. It is a simple circuit to construct with minimal components.

K 6050 **$16.45**

Induction Balance Metal Detector Kit

(See SC May '94) What a great kit. This is a simple to build metal detector. It is suitable for wet & dry ground, includes adjustments to eliminate ground effects, has a sensitivity control and audible indicator. It can detect a small metal objects such as a coin at a distance of about 20cm. Please note this kit is supplied in short form. i.e. does not include PVC piping (standard electrical or plumbing pipe available from hardware stores) nor the plastic plate for the coils.



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NEW

K 1250 **$59.95**

Midi Breakout Box Kit

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(See EA Feb '94) To make use of the Midi facilities on your "Soundblaster" card on your PC you will require a breakout box. This kit plugs into the joystick port of the Soundblaster card and gives 2 midi out ports, 1 midi in and 1 midi though port. Included is a pass through socket which allows a joystick to remain attached. The kit is fitted with the standard 5 pin din sockets. Does not include synthesiser software required.

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1 x 3mm x 135mm

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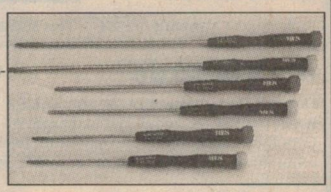

Includes 3 flat blades and 3 cross head screwdrivers. The screwdrivers have long shafts which make them ideal for reaching recessed screws. Handles are made from moulded plastic, and incorporate finger grips. Shafts are made from nickel chrome molybdenum.
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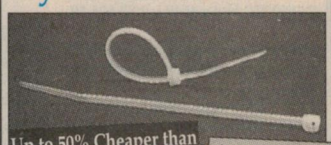

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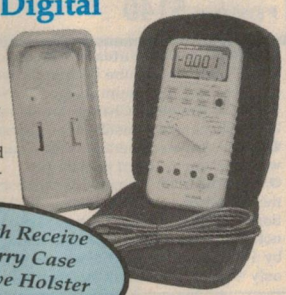

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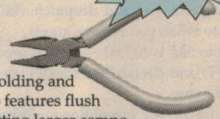

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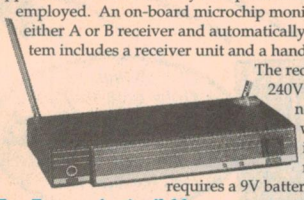

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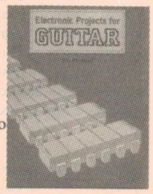

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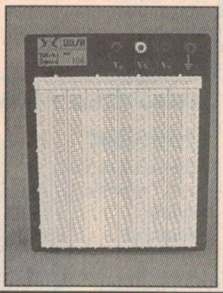

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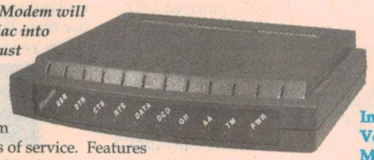

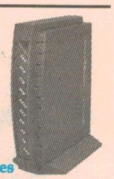

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Fax Modes:.....V.17, V.29, V.27ter, V.21
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Error Correction:.....MNP Class 2-4
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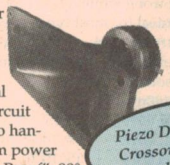
Motorola Piezo Ceramic KSN1141A



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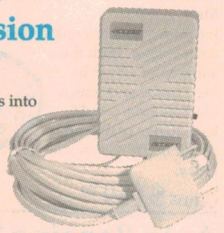

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The new Commodore C-4 ECU

A reader from Mosman in NSW has written to me asking why his new VR Commodore has a new on-board computer, and also an electronic transmission. The reason is that the VR's new electronically controlled transmission requires a control module, and the old reliable C-3 ECU was only designed to control engine management and TCC (torque converter clutch) lock-up. So the VR has a new reliable ECU, the C-4, which controls the transmission as well as the engine.

Because the operation of the engine and transmission are so intimately connected, GM decided to control the transmission with the same unit that controls the engine. GM also decided on making numerous name changes (or maybe they recently hired a bunch of engineers that didn't know the old names!).

To get this part out of the way first, here's all the name changes. The ECU or ECM, whichever you prefer, is now an IPCM (integrated powertrain control module) or PCM for short. The CEL (check engine lamp) or CES (check engine soon) indicators are now the 'powertrain lamp' or 'PTL', with powertrain being one word, in American English. If this lamp illuminates, you may have engine *or* transmission problems. The MEMCAL (memory calibration) unit is now the PROM, the generic name for the device.

The C-4 PCM

The new C-4 is essentially an upgraded C-3 engine management system, with expanded capabilities to control an

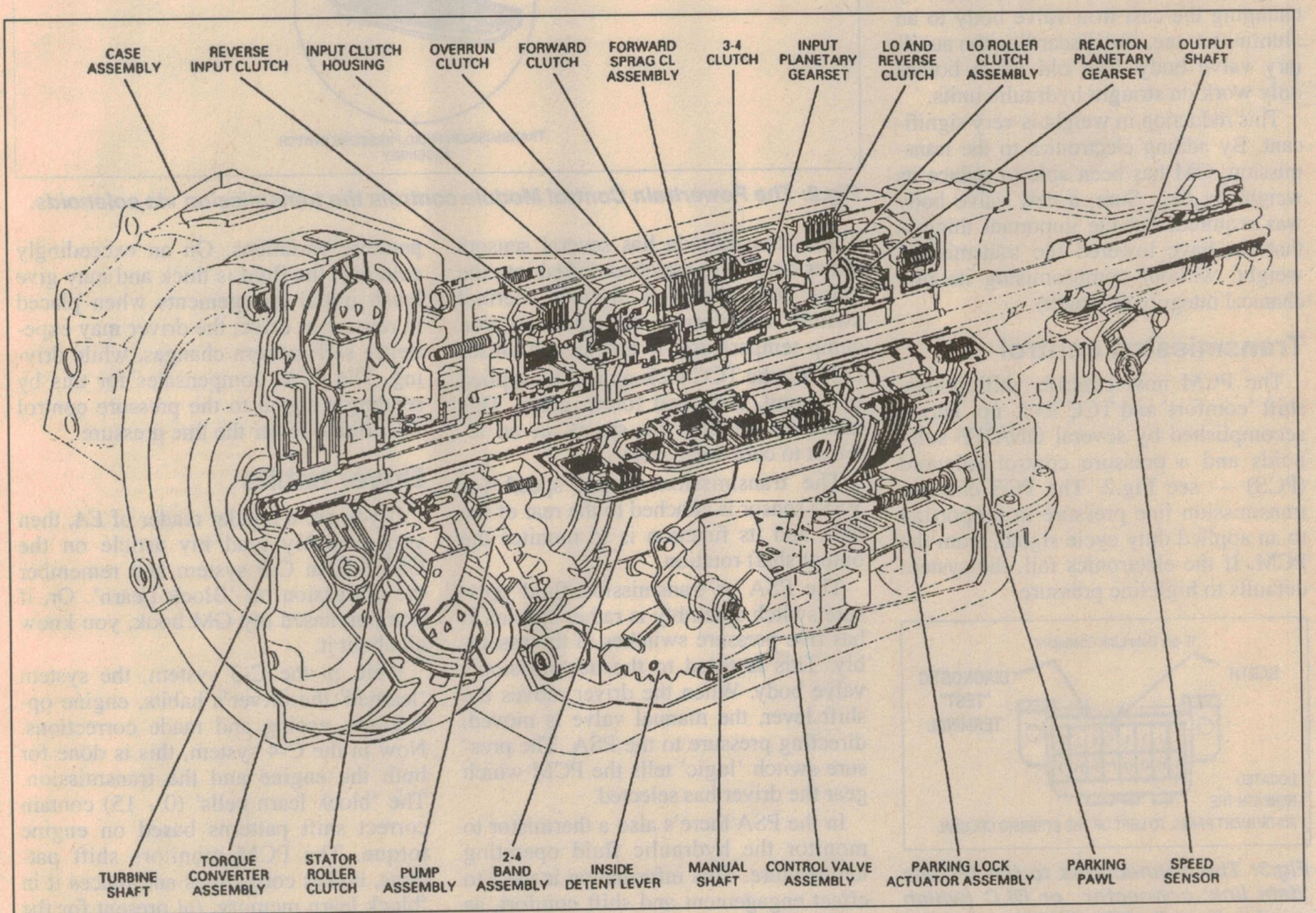


Fig.1: The new Hydra-Matic 4L60-E transmission is based on the proven THM-700/4L80 fully hydraulic transmission.

electronically operated transmission. It has a higher I/O data rate of 8192 bits per second, versus the C-3 at 160.

The new PCM required additional hardware, since it now has to control the transmission solenoids. So for openers, drivers had to be added and of course, additional I/O ports. It also required an additional 64K of memory.

The new transmission is basically the same as the unit in the VN Commodore, with the electronic control added. The old designation was the THM-700 (now 4L80), a proven transmission that's been around for years. With the electronics added, it becomes a Hydra-Matic 4L60-E (see Fig.1). Yes, you're right, the 'E' stands for electronic. (NOTE: For any automotive history buffs, THM stands for 'Turbo Hydra-Matic', a company owned by General Motors. They recently dropped the Turbo from their name and became the Hydra-Matic company.)

The present transmission is a lighter weight version of the older unit. The weight reduction was accomplished by changing the cast iron valve body to an aluminium one, and discarding the auxiliary valve body. The old valve bodies only work on straight hydraulic units.

This reduction in weight is very significant. By adding electronics to the transmission, GM has been able to reduce its weight by 6kg. Sure, a new valve body was required, but the important thing is that we have lowered the transmission weight, without compromising its mechanical integrity (strength).

Transmission control

The PCM now controls shift points, shift 'comfort' and TCC lock- up. This is accomplished by several ON/OFF solenoids and a pressure control solenoid (PCS) — see Fig.2. The PCS changes transmission line pressure in proportion to an applied duty cycle signal, from the PCM. If the electronics fail, the system defaults to high line pressure.

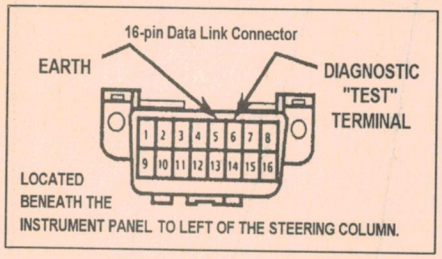


Fig.3: The connections to the IPCM's 'data link' connector or DLC (which used to be called the ALDL).

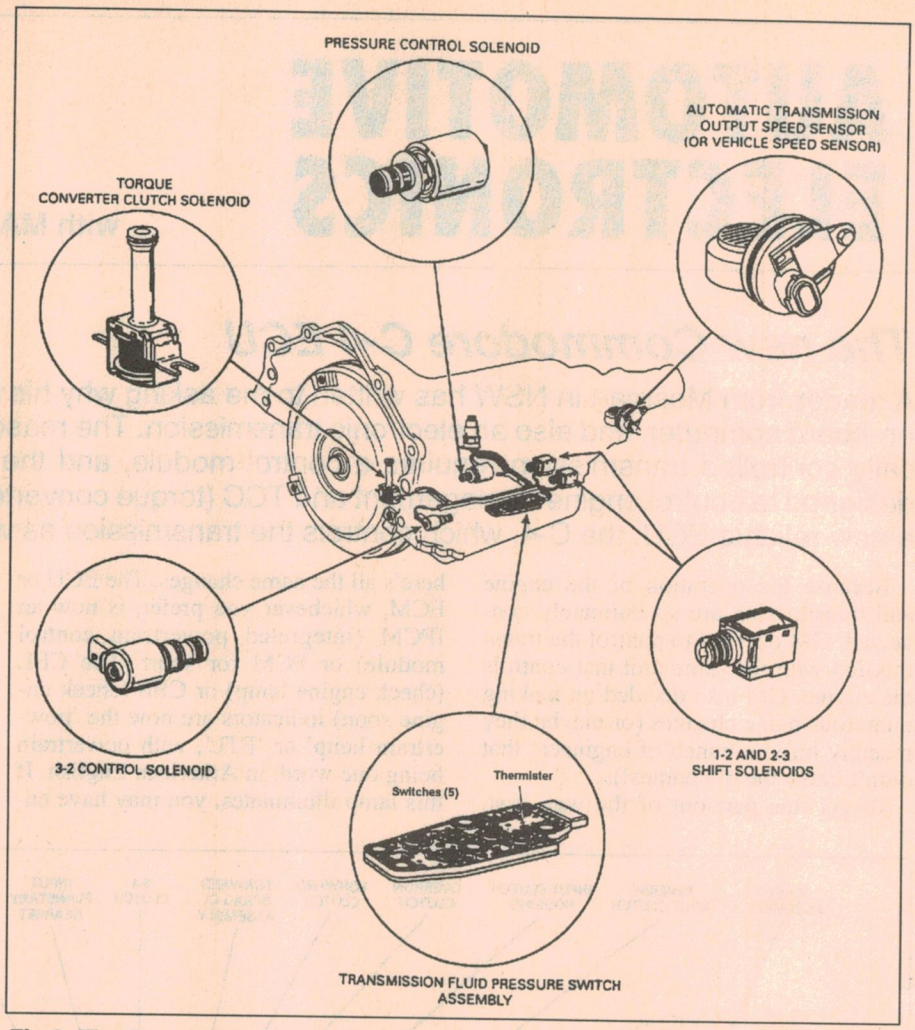


Fig.2: The Powertrain Control Module controls the transmission via solenoids.

The transmission has several sensors either built-in or attached. Fitted into the valve body there's a bi-metal thermal switch monitoring the transmission sump temperature. If this switch closes (131°C) the TCC lock-up will be applied in second, third and fourth gears. This increases cooling fan speed, in an attempt to cool the system.

The transmission output speed (or VSS) sensor is attached to the rear of the unit, and its function is to monitor the output shaft rotation.

The PSA or transmission fluid pressure switch assembly is rather special. It has five pressure switches in the assembly. This is fitted to the transmission's valve body. When the driver moves the shift lever, the manual valve is moved, directing pressure to the PSA. The pressure switch 'logic' tells the PCM which gear the driver has selected.

In the PSA there's also a thermistor to monitor the hydraulic fluid operating temperature. This information is used to effect engagement and shift comfort, as the fluid viscosity changes, due to temperature variations. On an exceedingly cold day, the fluid is thick and may give harsh initial engagements when placed in reverse or drive; the driver may experience shift pattern changes, while driving. The PCM compensates for this by sending a signal to the pressure control solenoid to lower the line pressure.

Driver habits

If you are a regular reader of *EA*, then you probably read my article on the GM/Holden C-3 system and remember the discussion on 'Block Learn'. Or, if you purchased my GM book, you know all about it.

Well, in the C-3 system, the system 'learned' the driver's habits, engine operations, ageing and made corrections. Now in the C-4 system, this is done for both the engine and the transmission. The 'block learn cells' (0 - 15) contain correct shift patterns based on engine torque. The PCM monitors shift patterns, makes corrections and places it in 'block learn memory' (at present for the 1-2 shift only). This information remains

in 'block learn memory' as KAM (keep alive memory), until 50 key on/off cycles occur or unless someone disconnects the battery.

Just think about it: the PCM continuously tries to make the transmission shift better, in a more comfortable manner and in such a way that it'll last longer. How about that?

Diagnostics

Like other GM/Holden systems, the C-4 has diagnostic trouble codes and a data stream output. Of course to read data stream requires special equipment, like a data scanner. For the transmission there are 22 codes, 17 specific and 5 shared by the engine management system.

The codes may be read in the same manner as before. This is accomplished by bridging the DLC or 'data link connector'. (Note that here's *another* name change — it used to be the ALDL, or assembly line data link.) However the DLC is physically different from past connectors, with a total of 16 pins (Fig.3).

Unbend a paper clip and bridge pins #5 and #6; then turn the ignition key on, but do not start the engine. The engine's fan will come on, and the PTL will start blinking a code '12'. This code indicates 'No RPM', which is a normal code with the engine not running. It will repeat this three times, then flash any other codes, three times also, then flash a code 12 again, when finished.

Do not act upon any of these codes. This means don't remove any parts, run down to the dealer or otherwise panic. You may simply be reading *history* codes. Of course, if the PTL was blinking when the ignition was turned on, or remained on after engine start, you have a current trouble code.

What's a history code, I hear you ask? Well, if any fault has occurred, for any reason, a code may be set — even if it happened just once and is not currently present. If a fault did occur in the past, what's past is *history* — right?

History codes?

History codes are stored in memory, but they will not turn on the PTL and they will not effect 'block learn'. You cannot erase them unless you have a data scanner.

So, how does one know whether the codes read are current fault codes or history codes? Thought you'd never ask.

It's quite simple, actually. With the bridge in place, just turn the ignition off and disconnect the battery. After 10 seconds, reconnect the battery, turn the ignition on and read the codes, if any. The *current* trouble codes will disappear, while the codes that remain are history. Of course an autotech will generally have a data scanner, which differentiates between codes.

Trouble codes

The code data for the C-4 system comprises two full pages, too much space for this article. But let's see what they will tell us.

The five shared (engine) codes effect engine and transmission operations.

SHIFT SOLENOID LOGIC

RANGE	GEAR	1-2	2-3
D	1st	ON	ON
	2nd	OFF	ON
	3rd	OFF	OFF
	4th	ON	OFF
3	1st	ON	ON
	2nd	OFF	ON
	3rd	OFF	OFF
2	1st	ON	ON
	2nd	OFF	ON
1	1st	ON	ON
	2nd	OFF	ON

Fig.4: The way the transmission solenoids are used to select each gear.

Codes 14 and 15 signify hot and cold engine conditions respectively, which controls TCC lock-up. Codes 21 and 22 indicate a low or high TPS signal. These extremes mean no TCC, fixed shift points, harsh shifts, high line pressure and no fourth gear, if hot (22). Code 24 (no VSS), besides turning on the PTL, will have a very harsh shift to second gear and remain in second gear.

The remaining 17 transmission codes have various effects on transmission operations. These are specific codes indicating a component, solenoid or sensor failure.

Code 68 is a classic example of programmers using what's available (sensor data) to provide additional information. This code indicates that when in fourth gear with the TCC engaged, a transmission slip of over 100rpm occurred. This means that some component in the transmission has slipped. The data used to determine the slippage is engine RPM and transmission output speed (VSS).

Here's a fix from the field — no, it's not in the factory book. If you experience harsh shifts and the PTL comes on, check for a blown fuse number 14. This fuse supplies power to the pressure control solenoid circuit. This power circuit is shared with other circuits that have nothing to do with the transmission.

Transmission operation

So, the new C-4 PCM controls shifting, comfort and TCC lock-up. To accomplish these operations, the PCM must have sufficient data from transmission and engine sensors. For shifting the PCM must know transmission fluid temperature, to control the quality or comfort of the shift. For the correct shift point, the PCM must know the TPS (throttle position sensor) and the VSS readings. It then checks with the 'block learn cells' for the correct shift per torque curve, if within limits, a shift is executed.

Lock-up: For TCC engagement the engine temperature must be higher than 65°C. When this temperature is reached the TCC applies in third and fourth gears, under normal circumstances.

Shifting: The PCM controls transmission shifting by turning on/off the 1-2 and 2-3 shift solenoids. This is simple relay logic; it cannot get much simpler. The 3-2 solenoid controls down-shifting only.

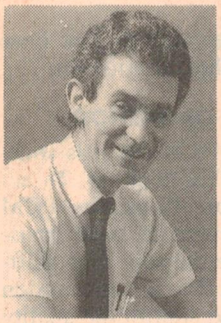
Notes that the 1-2 and 2-3 solenoids are energised when the ignition is turned on. They are both on in park, reverse and neutral. Reverse is a hydraulic function and does not require shift solenoids. In range 1, the 2nd shift occurs above 48km/h.

What happens to the transmission if there's an electronics failure? In the unlikely event that the electronics fails, the system defaults to the hydraulic system. In default, the line pressure goes high and the transmission will remain in third gear. Reverse will still be functional. In default mode the PTL will illuminate when the engine is running.

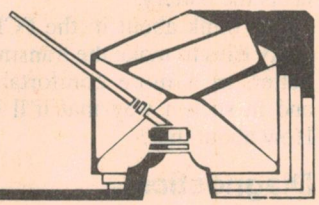
If you have access to a data scanner, like GM's Tech-I or SPX's Monitor 4000, you can observe the transmission operation live via the data stream facility. If a fault occurs while driving, it may be captured (recorded), played back and viewed on a terminal screen. Lots of fun, and an aid to finding faults.

Summary

At a recent seminar on the new C-4 and transmission, one participant exclaimed that the computer was getting smarter. I shook my head and thought — no, the programmers are simply starting to earn their keep. As I have said before, 'The more the programmers learn about automotive operations, like how a car works, the better the product works'. We're at last seeing this, with G-M's new C-4 PCM. ❖



Information centre



Conducted by Peter Phillips

Anecdotes, questions and answers

We open with some reasons why an RCD (residual current device) might not behave as the manufacturer says it will. Then we give an equation to find the VA rating of a C-core transformer, and discuss many things — including cellular phones, TV monitors and more.

You might be wondering when the discussion in these columns on RCD's is going to end. However, because these devices are becoming so widely used, an increasing number of technically inclined people are likely to be interested in the problems caused by an RCD, and more importantly, how to solve them. For that reason, I'm keeping the topic open, at least for this month.

Our opening letter is in reply to one I presented in June, where contributor J.E. (Woodville, SA) described a situation where an RCD fitted to his power circuit would occasionally fail to trip when the test button was pressed. As well, J.E. pointed out that he has received two severe electric shocks that didn't cause the RCD to trip. The manufacturer's representative could only offer the comment 'electricity does funny things'.

As well, J.E.'s letter might have left the impression that RCD's are not all they're cracked up to be. Like everything, there's a logical answer why an RCD won't trip; all we have to do is find it.

The explanation of J.E.'s problem offered by our opening letter may be the right one; maybe not. But certainly it's interesting to us all, and therefore well worth presenting. The writer has plenty of qualifications in this area, as he was part owner of, and design engineer for a company called Electronic Safety Products, before it was sold to Clipsal.

And as it happens, our old friend R.V. (St Georges Basin, NSW) also has two RCD stories, one that supports the first letter and another that's equally as interesting.

Neutral-earth faults

I read with interest about J.E.'s RCD problem. By his own admission, J.E. has a rough lighting installation if it has a leakage current to earth of 600mA. However, I'm led to the following conclusions if his RCD failed to test correctly.

In one or more of his power circuits there is likely to be a finite path between a protected neutral and ground. When a high current appliance is operated, or if the MEN street potential increases (it can be as high as 40V), it's possible for a low impedance neutral-earth path to generate a current approaching or being equal to the trip level of an RCD.

This is not well known, but is very common and one of the greatest sources of nuisance tripping.

A leakage current from a protected neutral to ground creates an imbalance in the toroid in the RCD. Any imbalance from a protected active to ground creates an equal and opposite induction in the toroid.

Depending on how it's connected in the circuit, the current via the test resistor in the RCD will either aid or cancel the neutral-earth leakage. The worst case is when the test current cancels, which prevents the RCD from tripping during testing. Holding the test button on will quickly burn out the one watt test resistor, confusing the situation even further. However, if the neutral leakage current is not there, perhaps because the MEN potential has reduced or the high current appliance has been switched off, the RCD will test properly.

J.E. did the right thing in asking for help, when the unit didn't test properly. Regarding his burnt thumb, the current flowing through a thumb is limited only by the series resistance (which could be as low as 80 ohms). Yes, it will burn in one cycle.

To prove the point, I suggest J.D. waits until the RCD won't trip, then try a leakage test from active to earth with a set of test lamps. If the unit trips, then it's clear the problem lies in the circuit being protected. At this stage, he should replace the RCD anyway, as the test resistor will very likely be suspect.

To clear future problems I suggest he disconnects all protected neutrals, separate each one and perform an impedance check to ground, looking for anything capacitive or resistive that's below 1M to ground.

Remember neutral impedance is cumulative, and the more neutrals the lower the impedance. In some installations, I have found earth/neutral connections past the switch board. Some safety minded electrician has connected the laundry earth plus neutral to the nearby water pipe. (G.D., Glen Waverley, Vic.)

Thanks G.D., it's good to hear from someone with design experience in this area. I'm sure few people would consider a leakage to earth via the neutral as an issue, let alone a problem. Now for R.V.'s anecdotes...

More RCD stories

A few years ago I installed a 40A RCD to protect all circuits in my house, except the hot water system. Prior to fitting the RCD, I had acquired a new computer. However, a few days later a momentary power failure caused its power supply to fail. It was replaced under warranty.

As a result, I decided to install a latching relay to prevent this happening again. In the event of a power failure, the relay would drop out and remain out until I pressed the start button, avoiding the power-on transient I assumed responsible for the demise of the computer power supply.

This arrangement worked OK until I installed the RCD. From then on, closing the latching relay would occasionally

cause the RCD to trip. I discovered that if the computer was switched off at its own switch, the relay could be closed, and the computer then switched on without ever tripping the RCD. Why?

Inspection of the internals of the computer power supply showed a network of three capacitors at the 240V supply entry. These are across the supply and from either side to earth. I had wired my latching relay to switch both active and neutral, but obviously the contacts couldn't make at exactly the same time, meaning that for a fraction of a second one contact only would be closed.

Assuming this to be the active, the capacitor connected between it and earth would be charged by an inflow of current which is not matched in the neutral side. Trippo! Or perhaps the relay contacts could bounce, with a similar result. I pursued the matter no further, as I had found a way around the problem with my start-up drill. So beware of double-pole switching if there are capacitor networks in the appliance being switched.

Number two funny is that the RCD once tripped when nobody was doing anything electrical. I couldn't reset the RCD, despite pulling out the plugs of all appliances and finally the fuses of everything but the hot water system, which was not in the RCD circuit. Still the RCD wouldn't reset.

Then it suddenly decided to do so. I noticed that the kWh meter had stopped rotating and then the penny dropped. The HWS had cut out, having just reached temperature. I raised the HWS thermostat setting and the meter rotated anew, but now the RCD wouldn't reset.

It turned out that the current being drawn by the HWS was causing a voltage drop in the neutral wiring, and an earth fault somewhere from neutral to earth was drawing over 30mA as a result of this small voltage. There was, of course, no matching current in the disconnected actives. I eventually traced the fault to a hotplate in the stove, which because it hadn't been used for sometime, had a low resistance path to earth. The problem was solved by heating the hot plate with a blow lamp.

So it's quite possible to have a neutral to earth leakage problem, and because the neutral is usually not disconnected by a switch, this type of fault can be very hard to find. (R.V., St Georges Basin, NSW.)

Again, thanks R.V. It's stories like this that help solve problems for others. Your story about the capacitive network in the computer power supply supports a point I made in March, that spike suppression capacitors are probably responsible for quite a few false RCD trips. Tricky things these RCDs!

C-core VA ratings

The next letter is in response to a reader's query in the June issue:

In June, a reader was looking for the formula to find the VA rating of C-core transformers. The reason these transformers need their own VA formula is because the ratio of window area to core area is quite different to that of 'wasteless' laminations. Even then, the formula is really only valid for cores with an approximately square cross section.

This can be seen when you consider a 3cm stack of 2cm centre leg laminations and a 2cm stack of 3cm centre leg laminations. In both cases the cross section of the iron is 3cm, but in the second example the window area is more than twice, so the VA rating is about double.

A more appropriate factor to use is the product of core cross section and window area. This factor, normally called Ap, is in cm^4 (or $inch^4$) and is often given in transformer catalogs.

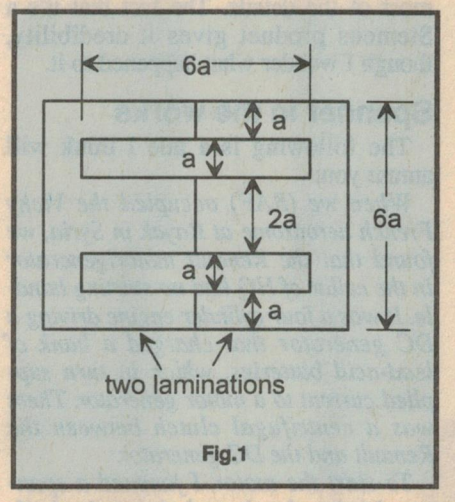


Fig.1

The formula I use to find the VA rating of a C-core transformer is VA = 1.32 x Ap if all dimensions are in centimetres (or VA = 55 x Ap for inches). This formula is based on a flux density of 1.7 tesla and a current density of around $3A/mm^2$. It bests fits a 150VA transformer, but can be used for transformers from about 50 to 300VA.

It must be stressed that this factor is for a transformer with one primary and one secondary winding with a 100% duty cycle, and refers to RMS current. A centre-tapped winding or multiple secondaries reduces the rating. For C-cores with a double section core, the rating is similar; increasing slightly for a core with a coil on each limb.

Applying the same logic to standard silicon steel laminations working at 1.3 tesla and $3A/mm^2$, the formula is approximately VA = 42 x Ap (dimensions in inches). (C.B., Pascoe Vale, Vic.)

Thanks for this information C.B., data on C-core transformers is a bit hard to come by. I'm sure this information will be useful to our June correspondent.

Going briefly back to E-I cores, here's an extract from a letter sent by a reader who has been out of the field for a while, but who has previously been involved in transformer design.

It helps to remember that E-I laminations are a 'scrapless' design, because there's no waste in their manufacture. The Is are punched from the Es, leaving the window space. The relative dimensions are thus set, and can't be altered. (L.L., Port Lincoln, SA.)

The rest of L.L.'s letter doesn't address the question of C-core transformer VA rating, but I thought readers would be interested in how E-I laminations are punched. Fig.1 shows the details.

A few questions

Here's a number of rather unrelated questions posed by a reader. *Have you published projects for cellular phones? I am considering buying a handheld but the range is limited so I would like a power amplifier to extend it. Also, a hands-free kit for the car would be nice. The 1990 RS catalog contains two Motorola voice switched speakerphone chips, MC34018P and MC34118P at about $30. From the description, they contain most of the circuitry for a hands-free kit.*

Secondly, how does a car stereo front-rear speaker fader work? All I can come up with is a quad-ganged log potentiometer, but this seems like wasted power.

Thirdly, if I built a stereo sound decoder for a television set, does a mono video recorder record a large enough bandwidth to recover stereo from a tape, or are separate tracks recorded in a stereo video?

Finally, have you had any circuits for electronic ballasts for fluorescent lights ranging from 15W to 40W. Also, how about a defined correspondence address. (G.B., San Remo, NSW.)

Concerning cellular phones G.B., I assume you mean a power amplifier for a car, as such an extra would turn a 'portable' into a virtual fixture. We haven't looked at such a project as this field is pretty well covered by commercial products. It's a rather specialist field as well.

A car stereo fader is either active or passive. An active system is built into the radio unit, which has one power amplifier

per speaker. The fader simply adjusts the signal level to each amplifier.

A passive fader uses a wire wound potentiometer to adjust the relative level between front and rear speakers. The arrangement used by Becker (in most Mercedes cars since at least 1978) is shown in Fig.2. The especially made fader has a 40 ohm resistive element with two extended metal sections. The arrangement is circular, but for clarity, I've drawn it as a slide resistor. In its mid position, the slider supplies each speaker directly from the power amplifier. When moved either way, one side of the wiper contacts the resistance element, while the other remains in contact with a metal extension. One speaker now has a resistance in series with it and the amplifier, the other still has a direct connection.

This arrangement is duplicated to accommodate a stereo system. When set to its mid position, there is no lost power, and both speakers have an equal output. Turning past the mid position introduces a power loss in one direction, but none in the other. Simple, but effective.

Now to your question about stereo TV. When a TV transmission is recorded on a VCR, the video and sound are demodulated from the carrier and recorded as separate signals on the tape. It's therefore not possible to restore the stereo information from a mono signal, as it's lost in the mono recording.

The last time we described an electronic ballast for fluorescent lights was in December 1983. And as for a defined correspondence address, you'll find it on the last page of every edition of EA.

More on the Neotherm

In July, I included a letter from a reader about a primary battery known as the Neotherm. According to the information sent to me, the battery, circa 1910, could be charged by heating it. Seems almost too good to be true, doesn't it? Well, here's a few more lines about this battery, sent to me by our original correspondent...

I've since searched through the Motor Manual (the text describing the Neotherm as sent before) and have found a few more lines on this battery in a section titled Charging from a Primary Battery. It reads thus:

'An excellent charging battery is the Siemens Neotherm type. Each cell consists of a cast-iron rectangular cell, lined with copper oxide. Inside is mounted a zinc plate. The electrolyte is caustic soda. The copper oxide lining can be restored indefinitely by baking the case in an oven at 300°F. Each cell gives 1.1 volt and does not polarise or run down on open current like a bichromate cell. (K.E., Henley Beach, SA.)

So again, if anyone has further information on this battery, please let me know. Perhaps someone might even try building a Neotherm, as we now have most of the details. The fact that it's a Siemens product gives it credibility, though I wonder what happened to it.

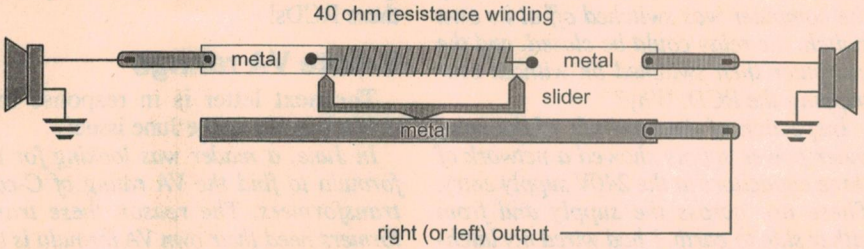


Fig.2

Spanner in the works

The following is a tale I think will amuse you:

When we (RAF) occupied the Vichy French aerodrome at Rayak in Syria, we found that the Renault motor/generator in the cellar of HQ had no starting handle. It was a four cylinder engine driving a DC generator that charged a bank of lead-acid batteries, which in turn supplied current to a motor generator. There was a centrifugal clutch between the Renault and the DC generator.

To start the motor, I jammed a spanner in the clutch and threw the knife switch connecting the batteries to the DC generator. The sequence of events went like this:

The spanner in the clutch flew out and ricocheted around the cellar, much to my consternation and alarm. As well, using the generator as a motor meant its residual magnetism was reversed, and therefore its output voltage as a generator was reversed. In between dodging the flying spanner, I had to open the knife switch and then reverse the output leads of the generator. But at least this got us on the air and in communication with Beirut!

All future start-ups were done wearing a tin hat and an issue gas mask to avoid bodily damage from the flying spanner. I also wore rubber gloves to avoid electrocution. (G.B., Bomaderry, NSW.)

A good story, G.B. — it seems war time ingenuity knew few bounds!

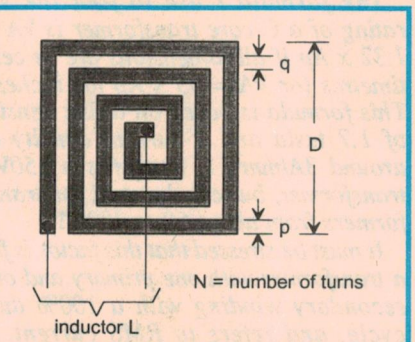


Fig.3

PCB inductor

The next letter is in response to a reader request I included in June, about an equation to find the value of a PCB inductor.

Concerning an equation to find the inductance of a PCB inductor, The Electronics Equations Handbook by Stephen J. Erst includes two for a square spiral inductor. I'm not sure how relevant these equations are to the Oatley Electronics designs, which are only a single turn. However, I can't see why one couldn't use a value of one for the number of turns in the simplified equation. (D.J., Lethbridge Park, NSW.)

Thanks for sending me this information, D.J. It's shown in Fig.3, and I'm sure quite a few readers will want to keep this information on file. Now for another reader enquiry...

TV monitor

Have you published the design of a television monitor? My reason for asking is I want to connect a video signal to a TV set that doesn't have a video input. Also, is it difficult to feed a video signal directly into a TV set other than through the antenna connection? (R.C., Seaforth, NSW.)

You don't mention whether you want a colour display, but if you are only after

monochrome, it's usually quite easy to convert a mono TV set into a monitor. It's not possible to give a definitive method, as there are so many circuit variations for TV sets.

The usual way is to connect into the video buffer stage, which is the stage following the video detector, itself after the video IF stage. If you don't want to preserve the receiver side of the TV set, simply cut the connection from the detector to the video buffer, being sure to retain (or replace) any DC biasing required by the buffer. Otherwise, fit a selector switch. Then connect the video source to the input now vacated by the video detector. It's best to AC couple this connection via a capacitor (say 0.47uF or larger), to prevent DC interaction between the video source and the buffer stage.

We published an article titled 'Convert a TV set to a Colour Monitor' in the August 1986 issue, which might contain useful information. Otherwise, the only relevant construction article I can find is one presented in May 1974 on building a slow scan TV monitor. While this project won't solve your problem, it might give you some ideas.

Fluoro ballasts

Over recent issues there's been quite a bit of discussion on the best side to connect the ballast in a fluorescent lamp. Most people agree the neutral side is the best, for different and very valid reasons. But not everyone agrees, including the writer of the next letter:

My experience has highlighted an aspect which has not so far been reported in your magazine about the best side to connect a fluorescent lamp ballast. I'm referring to safety for those changing the tubes, particularly in an earthed metal fitting which uses spring loaded lampholders and a rapid start ballast wired in the neutral side.

In this fitting, the active is at a spring loaded lampholder, which means it possible for a tube to be inserted so one end touches the active while the other touches earth. The tube can therefore explode in the hands of the installer, as the ballast is not in the circuit to limit the tube current. As well, the hands of the installer are likely to help the tube to fire. Therefore, the type of ballast and lampholders should be considered before deciding where to connect the ballast. (K.P., Torrens Park, SA.)

I'm not sure if this is a compelling reason, as either way there is a significant danger to the installer who insists on fitting a fluorescent tube while the power is on. Having a tube light up in the hands of someone perched on the top of a ladder is hardly a recipe for self-preservation. However, I agree that a ballast in the active would prevent the tube exploding, while one in the neutral wouldn't...

The next contributor to this topic also has what he believes to be good evidence on the virtues of connecting the ballast in the active side.

I am not an electrician, but I have bought a number of fluorescent light fittings from Government surplus, and have found that lights wired with the ballast in the neutral are usually in far worse condition than those with the ballast in the active side.

Typically, the ballast and other parts of the fitting show signs of considerable overheating, and quite a few have obviously been fitted with a new ballast in the course of their lifetime. Other light fittings with the ballast in the active side look almost as good as new. (C.H., Warrnambool, Vic.)

While I can't see why a ballast in the neutral side of the tube will get hotter than one in the active side, one can't refute visual evidence. Of course, C.H., I'm assuming you knew for sure how the active and neutral wires were connected to the fitting.

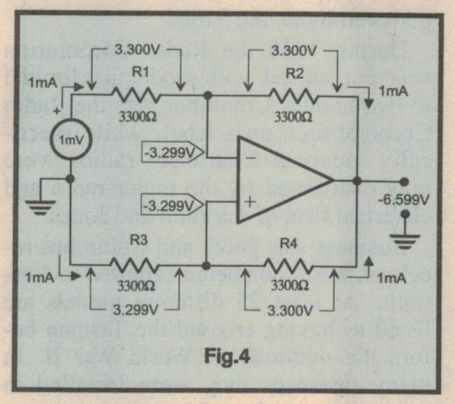


Fig.4

What??

The question this month comes from Ron Voller (St Georges Basin, NSW) who admits its origin in Peter Falk's *Columbo*. Here's the question:

You need a number of 11 ohm resistors, which are mixed up in a pile of 10 ohm resistors. They are indistinguishable from each other, but after hours with an ohmmeter, you finally have a handful of 11 ohm resistors neatly sealed in a plastic bag. Unfortunately, your ohmmeter falls on the floor and is wrecked.

After leaving the workshop, you return later to find your helpful young son has been observing what you were doing and has now put a handful of 10 ohm resistors into each of several bags, identical to the one containing the 11 ohm resistors. He has also sealed the bags, just like Daddy did. You now have a pile of identical plastic bags containing identical looking resistors, one of which is the bag containing the hard won 11 ohm resistors.

After due thanks to Junior, you telephone your friend Joe to borrow his ohmmeter so you can sort out the bags. Joe arrives, obviously in a hurry, and says he's only got time for you to do one quick measurement.

'One will be enough.' you say. How so?

Answer to August's What??

The output voltage is -6.599V. Because the op-amp is ideal, the differential input voltage at the op amp inputs is 0V. Therefore the voltage drop across R2 and R4 must be equal, and the current in these resistors must be the same.

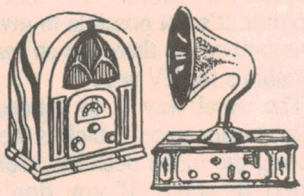
Because no current flows into the inputs of the op-amp, the current in R1 equals the current in R2, as does the current in R3 and R4. The voltage from the inverting input to ground must also equal the voltage from the non-inverting input to ground. However, there's a one ohm difference in the values of R1 and R3, and there's also a 1mV voltage source in series with R1. Therefore the voltage drop across R1 is 1mV different to that across R3. Because the resistors differ in value by one ohm, the current to make the 1mV difference is 1mA. So the current in all resistors is 1mA.

The direction of the current in R1 must give a voltage drop with a polarity that opposes the 1mV source, so current flows from left to right. Putting all this together gives the voltage drops shown in Fig.4.

This circuit therefore produces a positive output if R3 is slightly higher than R1, and a negative output if it's slightly less than R1. ❖

Vintage Radio

by PETER LANKSHEAR



RCNZ's Columbus in Australia

Although the Australian and New Zealand radio industries developed their own individual styles and products, there was some interchange. As it is interesting sometimes to see how the neighbours do things, this month we look at one of several Radio Corporation of New Zealand models that were exported to Australia.

Prior to 1930, Australian radio equipment came from many sources, especially Europe and America. As well, there was a range of locally made products, ranging from small components right through to complex superheterodyne receivers. These provide today's collector of early equipment with a fascinating variety to choose from, although admittedly there is never enough material to satisfy everybody.

During 1930, the Australian Government introduced a tariff system to protect and nurture local radio manufacture, and consequently the quantity of imported equipment was reduced considerably. The scheme was successful, and one significant benefit was that Australia was able to develop an extensive electronics industry which made a valuable contribution to the War effort during the 1940's.

Although most importing of receivers ceased, there were some overseas made sets that did find their way on to the Australian market, at least two brands being from New Zealand. These were the 'Ultimate' receivers made by Radio (1936) Ltd. of Auckland, and the 'Columbus' models from the somewhat pretentiously named Radio Corporation of New Zealand, located in Wellington.

John Stokes' book *Golden Age of Radio in the Home* has a fuller history of RCNZ, but briefly the firm was founded by a White Russian, William Markoff, who had migrated to New Zealand in 1926. In 1931 he made some primitive receivers for Stuarts Hardware, situated in Courtenay Place in central Wellington. Understandably, the brand name chosen was Courtenay. Before long improved receivers were being made, and as was common practice, many were rebadged for other distributors. Among these names were Pacific, CQ, Stella and Troubadour and in 1935 Philips, who were still tied to TRF technology, contracted Radio Corporation to make their first superheterodyne, the 516P.

During 1936 the Radio Corporation was reorganised, with production limited to two brands. Columbus was the Radio Corporation's own label, while practically identical Courtenay radios were now distributed by the major radio and electrical firm of Turnbull and Jones.

Business was good, and Columbus receivers were soon being exported to Australia. At least 25 different models are listed as having crossed the Tasman before the outbreak of World War II. In many instances they were installed in Australian made cabinets, a common practice to reduce duty and freight costs.

Recently I was given a dual wave five-valve plus tuning eye Courtenay mantel type 35 receiver. As this was one of the models that was exported, it provided me with an opportunity to satisfy requests to describe typical Radio Corporation receivers and how to deal with them.

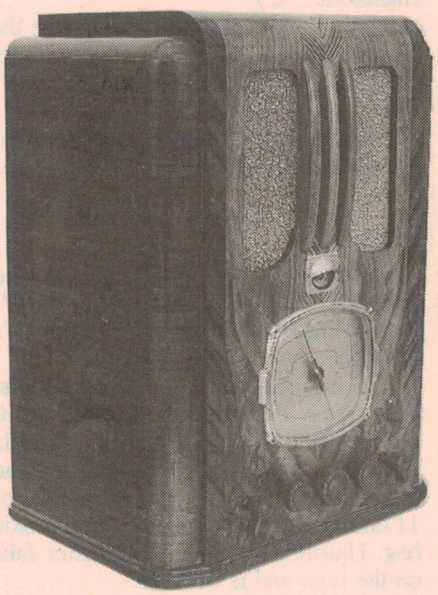


Fig.1: This handsome mantel cabinet, inlaid with no less than five different types of veneer, was but one of the patterns used for the Radio Corporation model 35 chassis.

Bandpass tuning?

With the exception of one feature, the circuit of the 35 is quite conventional, being basically the standard 'five valve' superhet comprising frequency convertor, IF amplifier, a combined detector and audio stage and power output pentode. For more than 30 years this format was the mainstay of the radio industry.

It will be observed that between the aerial and the control grid of the frequency converter valve, there are two broadcast band tuned circuits, coupled by the small capacitance created between two twisted pieces of wire. An alternative and more common method was inductive coupling with the two tuned windings wound on a common former.

This type of 'bandpass' tuning was standard in the early superhets that were without an RF stage and used an intermediate frequency of about 175kHz. The oscillator operated 175kHz above the signal frequency, with the resulting beat becoming the IF signal. However, if a transmission 175kHz higher in frequency than the oscillator got through to the converter, it would also produce an IF signal.

The selectivity of a single aerial tuning circuit could be insufficient to eliminate reception of this unwanted 'image', when it is only 2 x 175 = 350kHz away in frequency from the unwanted signal. Hence the use of double tuning, to improve the image reception.

However by the mid 1930's, intermediate frequencies were much higher — generally in the vicinity of 450kHz, thereby eliminating the need for an extra tuned circuit for image rejection. Colum-

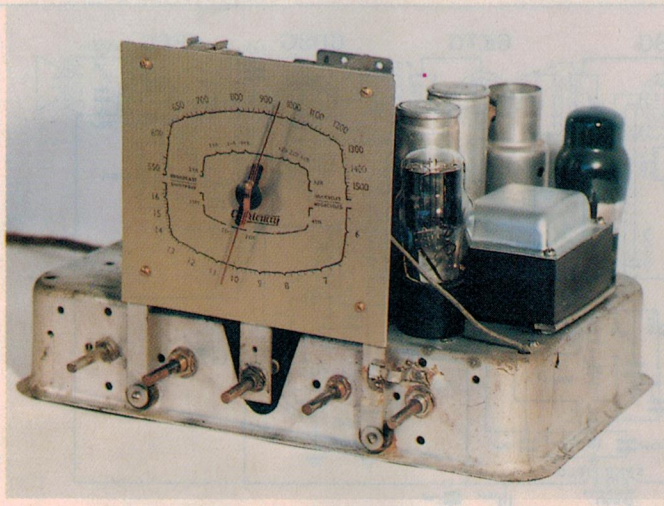


Fig.2: Radio Corporation frequently used a seamless chassis with rounded corners, much like a baking dish, which could be stamped out of a single sheet of steel — a novel construction that was both inexpensive and rigid.

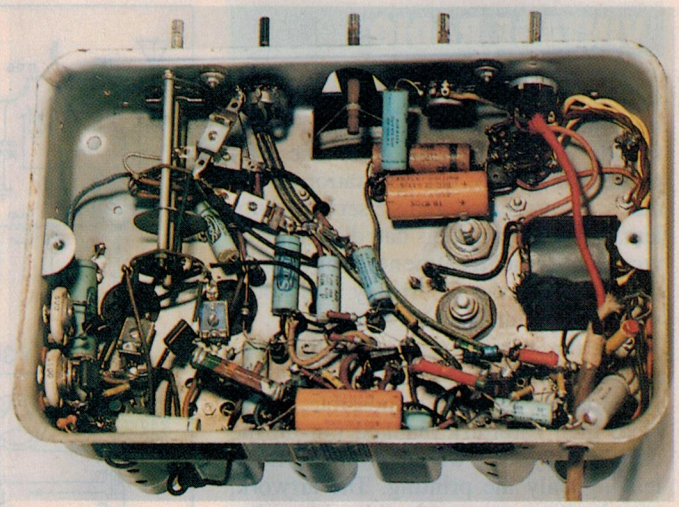


Fig.3: Underneath the chassis, showing that RCNZ wiring was reasonably tidy with many components supported on moulded standoff insulators. Here the original paper and wet electrolytic capacitors have been replaced.

bus had standardised on 456kHz around 1935 and as far as I can ascertain, in no other instance before or afterwards did they use bandpass tuning for receivers using this intermediate frequency. So why they used it in the model 35 is a mystery; a very odd situation.

There is a loss in signal transfer in these tuners, and it may be worthwhile experimenting with the capacitance of the coupling capacitor by varying the number of turns of wire.

Otherwise, the circuit of the 35 is quite conventional, but there are a few things to watch for when overhauling this and other Columbus receivers.

Damp storage, dirt

The cabinet on my receiver was in reasonable condition, although the lacquer had disintegrated to the stage where it was possible to scrape it off with a fingernail. A very grimy covering of what appeared to be a hardened mixture of oily soot and dirt covered the chassis. The aluminium coil cans and valve shields were, as well, pock marked with corrosion, indicating storage in damp conditions. Worst of all was the condition of the dial scale. This had been printed on metallic surfaced paper, which had deteriorated to the extent that it was covered with an unsightly etching of corrosion.

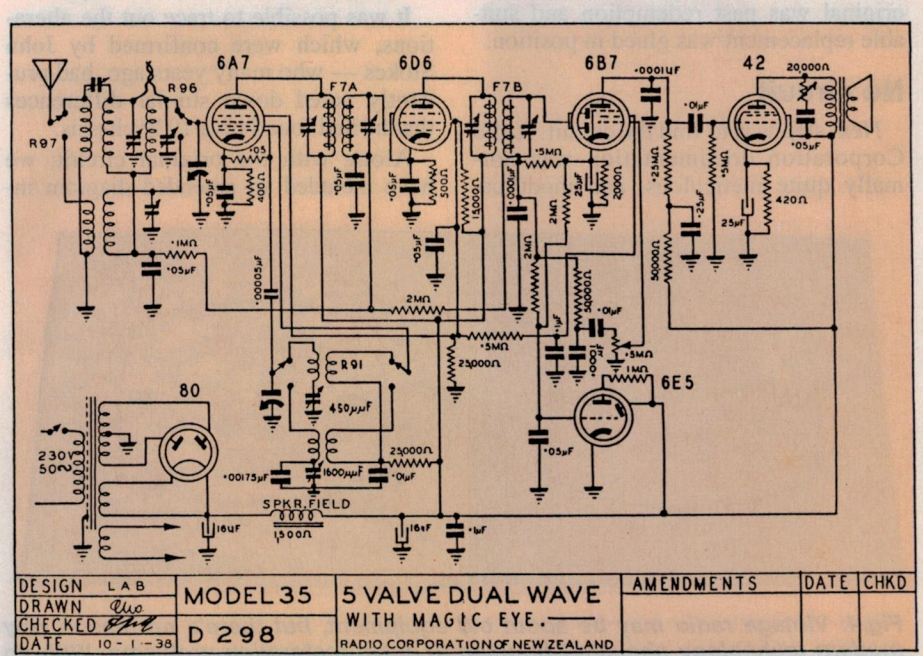
I made no attempt to 'try the set out'. It had in all probability been retired because it was inoperative, and storage conditions would not have improved matters. All that applying power would have accomplished would have been to confirm that the receiver did not go, and it is quite possible that there would have been further damage caused.

First the chassis was thoroughly cleaned. In an open-backed cabinet, a remarkable amount of grime can accumulate, and the nature of the dirt will often indicate where the set was used. Bedrooms leave a light dry fluff that can usually be removed with a vacuum cleaner. Coal gas fumes can leave a brown coating over metalwork, as can heavy tobacco smoking. Lounge rooms and offices produce dust that can be cleaned off with a small paintbrush and vacuum cleaner, but the deposits from cooking areas are more tenacious and can provide a clue to eating habits!

The worst case that I have ever encountered was a lovely old American Philco cathedral which had belonged to a bachelor, who fried everything. His radio had been for more than 40 years on a shelf immediately over his gas stove. The cabinet and chassis were completely coated in condensed grease; but when after considerable effort this was removed, the radio was found to be in quite good condition, having been practically 'embalmed'.

On the RCNZ chassis, what appeared to be a mixture of cooking oil and soot had produced very stubborn deposits. These required some hard work and patience to remove...

A dry pot scrubber gave the best results, although special care was neces-



Although RCNZ had used octal valves in previous receivers, the original 1938 version of the model 35 reverted to the earlier American standard valve series.

sary to avoid any strands of metal getting into the 'works'. Coil cans and valve shields were cleaned up with fine sand paper and Brasso, but restoration of the dial scale presented a more serious problem. Columbus models had different artwork, but the treatment about to be described for the Courtenay dial could well apply to many other scales.

First the original scale was photocopied, with the contrast reduced to subdue the blotches as much as possible. These were then carefully blanked out on the copy with typist's white correcting fluid, leaving only the printing. The artwork, now looking reasonably tidy although a bit pale, was scanned with a 'Logitech' hand held computer scanner and the image loaded into WordPerfect. A laser printer was then used to transfer the image to a sheet of metallic surfaced paper.

There was no question of salvaging the finish on the cabinet. However, the old perished lacquer was very easily scraped off with a wide bladed chisel and after sanding, the cabinet was polished to enhance the grain of the handsome veneers.

The surfaces of the brass escutcheons had suffered from the damp storage, and at first inspection they looked very discoloured. However a good rubbing with Brasso worked wonders, and coating with shellac varnish restored them to the right colour. Finally the grille cloth, which had been removed before the cabinet was scraped down, was given some attention. As is commonly the case, the original was past redemption and suitable replacement was glued in position.

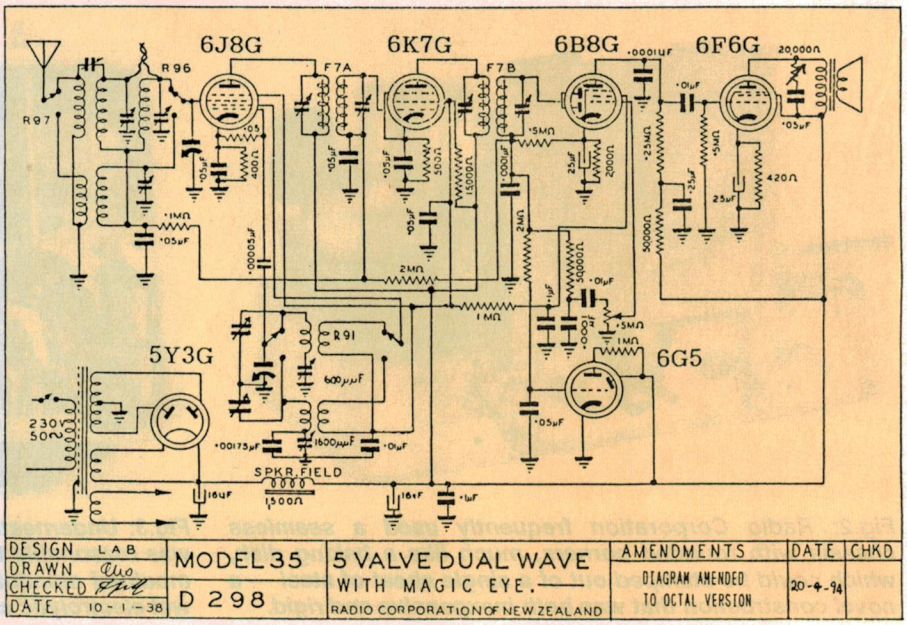
No circuit

Next step was to find the circuit. Radio Corporation documentation was normally quite meticulous, and modifications and production changes were regularly published. However, the system seems to have fallen down in the case of the 35. The only circuit that seems to be available is that the 1938 model which used the old standard pre-octal series of valves; but as luck would have it, my set, as well as some of the exported sets, has a 1939 chassis with glass octal valves. This would have been of little consequence had the first generation of octal valves, which were direct equivalents of the older valves, been used throughout.

It was possible to trace out the alterations, which were confirmed by John Stokes — who many years ago, had prudently noted down similar differences that he had found on a 1939 chassis.

Along with the original circuit, we have included an amended diagram incorporating the modifications for the octal version. Most significant changes were due to the use of the recently introduced 6J8G triode-hexode frequency converter in place of the old 6A7 pentagrid. This entailed operating the oscillator from the 100 volt RF screen grid line, rather than from the HT via the usual 25k dropping resistor.

Another variation is quite minor. By eliminating a 2M resistor in its control grid circuit, the drive to the tuning indicator was increased. This was probably to suit one of the newly announced remote cutoff type 6G5 indicators.



RCNZ were normally careful to ensure that circuit modifications were well documented, but although there were some significant changes, they appear not to have published a circuit of the 1938 octal version of the model 35. This amended diagram incorporates the known changes in the second model.

Leaking capacitors

Radio Corporation frequently used green labelled TCC paper capacitors in their pre-war receivers and there were still some present. These capacitors seem to be very susceptible to moisture absorption, and are practically certain to have very low insulation resistance. I do not even bother to measure their resistance before replacing them.

There were already second or third generation electrolytic capacitors fitted, and the two can type filter capacitors, long since dried up, were cleaned and left in position for appearance.

To reduce the 250 volt high tension to about 100 volts for the converter and IF amplifier screen grids, RCNZ frequently used a 15k/1W carbon resistor. The dissipation under these conditions is 1.5 watts, and consequently over the years, it is usual for these overloaded resistors to have increased in value.

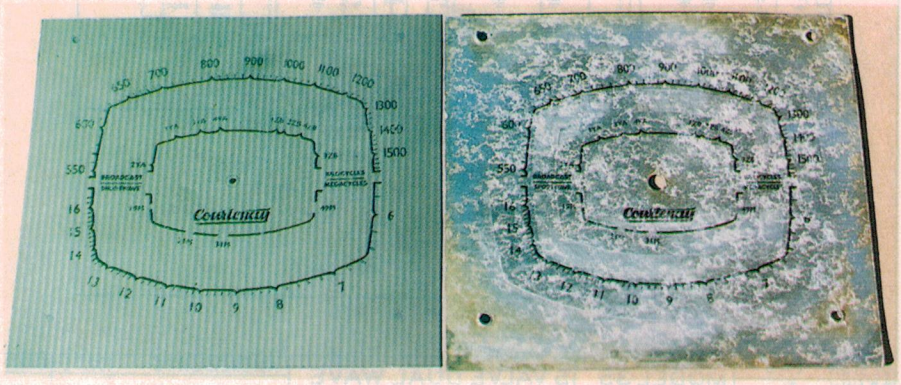


Fig.4: Vintage radio may be about old equipment, but there's no reason why modern technology shouldn't be used to solve restoration problems. With no way of reviving the corroded dial scale at the right, the replacement was made with the aid of a photocopier, computer and laser printer.

VALVES & SUITABLE ALTERNATIVES

VALVE FUNCTION	FIRST MODEL	FIRST MODEL SUBSTITUTES	OCTAL MODEL	OCTAL MODEL SUBSTITUTES
FREQUENCY CHANGER	6A7		6J8G	6K8, ECH35, X61, X65
I.F. AMPLIFIER	6D6	78	6K7G	6U7G, 6S7G EF39, KTW63
DETECTOR/ 1ST AUDIO	6B7	6B7S	6B8G	6G8G, EBF32
OUTPUT	42		6F6G	KT63, 6V6G*
TUNING INDICATOR	6E5	ANY 6 PIN	6G5	ANY 6 PIN
RECTIFIER	80		5Y3G	U50

* With the operating conditions of the model 35, a 6V6GT or G is an effective replacement for a 6F6G.

Original and alternative valves for both versions of the model 35. Metal, G and GT valves with the same type number are interchangeable.

They can be replaced with a parallel pair of 27k and 33k 1W types.

RCNZ operated pilot lamps at reduced voltage, prolonging their lives considerably. Often, there was a tap on the filament winding, but in the case of the model 35, although not shown on the diagram, there is a 1.5 ohm resistor made from a length of nichrome wire. For many years, Columbus and Courtenay receiver dials were lit with 6V/3W single contact medium bayonet based lamps. These are now hard to find, but worth trying are vintage car accessory suppliers, or long-established bicycle shops.

As with any set being overhauled, all high value resistors carrying any direct current should be checked. Especial attention should be given to the anode and screen grid resistors of the 6B7/6B8G. A resistor often overlooked but frequently high in value is the 1M tuning indicator anode resistor. As in many receivers, this is hidden away in the socket of the indicator valve.

Poor power tranny

One Radio Corporation component has been much criticised. Their otherwise generally very good equipment was marred by their power transformers. For some reason, these were not impregnated in any way, and failures were all too common. Furthermore, in pre-war sets, rubber insulated wire was commonly used for the high tension leads, and this is likely to be disintegrating.

The best repair method is first to disconnect and remove the transformer from the chassis. Then replace the perished insulation with spaghetti or heat shrink sleeving.

It is possible, by taking some trouble, to improve the chances of survival of Radio Corporation transformers by impregnating the windings with paraffin wax. I have treated many RCNZ transformers with the method about to be described, and do not know of a single subsequent failure.

Impregnating with wax

First undo the bolts and remove the cover, being careful not to damage the brittle paper insulation. Then, in a *temperature controlled* oven, heat in a large can a kilogram or so of wax to 120°C. Immerse the transformer complete with core in the melted wax, and leave until the stream of bubbles that will emerge ceases. This may take up to half an hour or so, and when activity has stopped, lift out the transformer to drain.

With the transformer still warm, refit the cover and tighten the bolts to force out any wax trapped between the laminations. Finally, a rub down with a cloth will remove all traces of wax from the exterior of the core.

This treatment moisture proofs the transformer and significantly raises the insulation rating of the paper. The temperature should be just above 100°, only sufficient to drive out moisture, and **under no circumstances should anything other than a heat controlled oven be used**. As well as being dangerous, wax directly heated on a stove element can get extremely hot and ruin a transformer.

Finally, Columbus speakers were quite well made, but check for an open-circuited output transformer primary winding. Normal primary resistance is around 400 ohms and the field winding should be nominally 1500 ohms.

All being well, you will now have a working example of a typical New Zealand made RCNZ receiver, and one that is capable of giving good service.

Coincidence?

Alex Ellison of Boondall in Queensland has sent me some photographs of his German Telefunken D799WK receiver that, although not identical, has remarkable resemblances to the Russian receiver described in the December 1993 column, even to the controls and dial and the arrangement of four loudspeakers. An interesting comparison — thanks, Alex. ❖

Request for AWA circuit:

Mr. W.V. Woods of Glen Iris in Victoria needs a copy of the circuit for either an AWA C174 or Radiola 240 eight valve table model receiver. Can anyone help?

MARKETPLACE

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50 and 25 years ago...

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September, 1944

A 35-ton mechanical brain: An electrically driven calculating machine weighing 35 tons and filling a room 51ft long, capable of solving mathematical problems from simple addition to dynamic equations of the solar system, has been presented to Harvard University by the International Business Machines Corporation.

The gift is the work of Commander Howard Aiken, US Naval Reserve who in civilian life is Mathematics Professor at Harvard and took eight years to develop.

It solves a problem in 5.8 seconds that takes a human an hour to do. In one case, it achieved in 19 hours what it took four persons three weeks to do, even with the aid of ordinary mechanical calculators.

It works out trigonometric functions in 88 seconds and contains error checking devices. When a problem is fed into the calculator in coded tape form it will carry out the solution to 23 significant figures consulting logarithmetic and other functional tables which lie in the machine or are coded on tapes.

The machine has already exposed 11 errors in one mathematical formula which has been standard for certain calculations for years.

Electron micro-analyser: Identification of atoms in ultra-microscopic particles of matter no larger than 1/100,000 of an inch in diameter can be accomplished quickly and accurately for the first time by a revolutionary new tool of science — the electron micro-analyser — developed experimentally by Dr James Hillier of RCA Laboratories.

The new instrument promises to go far towards overcoming one of the great barriers to the accumulation of knowledge about the infinitesimally small particles of matter of which all things are made. Information vital to the solution of many practical problems in the physical, chemical and biological sciences can now be obtained.

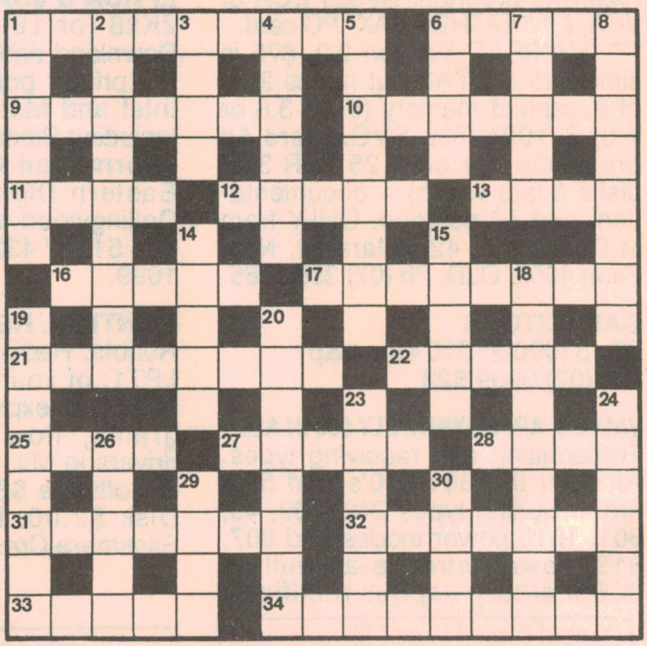
For the first time, the scientist, using this new instrument will be able to determine the chemical constituents of a particle weighing only 10^{-15} grams. And more important still, he will be able to see the relationship of the particles to the rest of the specimen under examination.

September, 1969

RCA colour TV demonstrations: RCA's new three tube colour television camera was demonstrated for the first time in Australia at the Institute of Radio and Electronics Engineers Convention. RCA gave a series of very impressive demonstrations of colour television under indoor studio conditions, but the question most often asked was does it perform as well outdoors?

Colour pictures of high quality were produced although the signals passed through two standard RCA TVM-1C radio links, The pictures are of the Yarra Glen races and an Association Australian Rules football match. ❖

EA CROSSWORD



ACROSS

1. Brilliant German physicist (1821 - 94). (9)
6. Not modern. (5)
9. Irradiate with high energy particles. (7)
10. Basic rules of electronics. (4, 3)
11. Brand of pager. (4)
12. Plastic substance. (5)
13. Terminating instruction. (4)
16. Charged particle. (5)
17. Like a thin fibre or filament. (8)
21. Covers to some degree. (8)
22. Junior engineer-in-training. (5)
25. Person credited with induction law. (4)
27. Mains induced noise. (1,1,3)
28. Assistance offered in program. (4)
31. Source of EMF. (3,4)
32. Axle of motor, etc. (7)
33. Compact in structure. (5)
34. Narrow range of frequencies. (9)

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DOWN

1. Name of space telescope. (6)
2. Brightness. (9)
3. Energy loss in most circuits. (4)
4. First name of composer of Choral Symphony. (6)
5. Inventor of the iconoscope. (8)
6. Shape of certain speaker. (4)
7. Superseded communication system. (5)
8. Period of inoperation. (4,4)
14. Items often associated with name of 1 across. (5)
15. Gemini program's launch rocket. (5)
18. Kind of spanner. (4-5)
19. Animals with a radio-tag can be ——. (8)
20. Laboratory carried by shuttle. (8)
23. Co-discoverer of spectrum analysis. (6)
24. Initial word in an SR system. (6)
26. Former name of radon. (5)
29. Prefix meaning at a distance. (4)
30. Perceive visually. (4)

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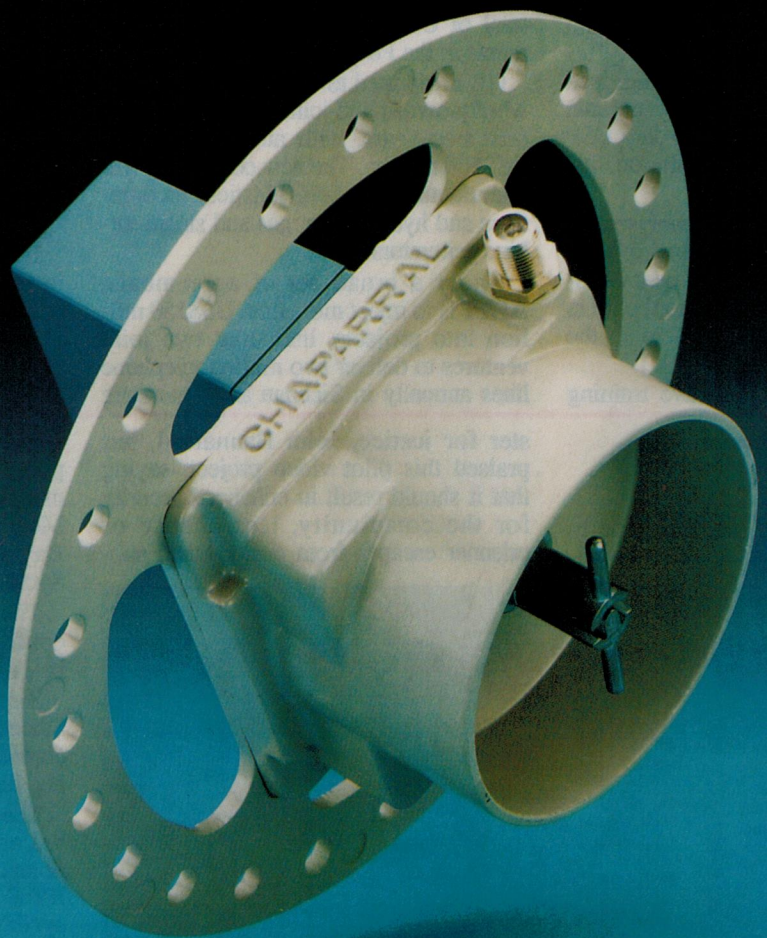


NEW CHAPARRAL INTEGRATED FEED AND LNB FOR C-BAND SATELLITE TV RECEPTION HAS BUILT-IN SKEW CONTROL, DIPOLE ANTENNA FOR HIGH CROSS-POLARITY ISOLATION

NEWS HIGHLIGHTS

INTERFACE 'FINE TUNES' BRAINWAVES

US firm Advanced Neurotechnologies, of Colorado Springs, has developed a multiple-hookup interface between human brains and computers, which is claimed to allow members of teams to 'synchronise' their brainwaves and achieve peak performance.

The BrainLink system passively detects brainwaves via a series of sensors attached to a headband worn by each user, similar to a traditional electroencephalogram (EEG). After amplification, the signals are digitised and converted to the frequency domain using a Motorola 56000 single-chip DSP performing a very high resolution fast Fourier transform (FFT).

The system software then analyses the amplitude and phase relationships between multiple sub-Hertz frequency ranges. The results are presented to the users on a graphical display, and also in the form of audio tones.

Unlike traditional brainwave training systems, BrainLink's DSP and proprietary protocols are claimed to allow very specific training in phase synchrony of brainwaves for people in teams of many types — negotiators, engineers, athletes and creatives.

LARGE FIRMS INVEST IN CHINA

According to *Hong Kong Trader*, US firms General Electric, AT&T, IBM and DuPont have committed to investing a total of US$840 million in joint investments in the People's Republic of China.

GE is reported to be establishing seven wholly-owned and joint ventures over the next two years, with an investment of US$500 million. The new companies will manufacture lighting, plastics, locomotives and hydropower, gas and steam turbine generators.

Under a broad set of agreements, AT&T is to inject more than US$150 million into projects, including two joint ventures to deliver two million telephone lines annually in Sichuan and Shandong provinces. The telecommunications giant will also establish a VLSI chip manufacturing facility, and will build a Bell Laboratories R&D centre.

IBM has pledged to invest US$100 million in information technology projects.

US personal computer maker AST has been selling PC's in China since 1985, and hopes to set up a manufacturing plant inside China by the end of 1995. During the next 10 years, China's banks and financial institutions alone are expected to spend around US$2.5 billion on a nationwide computerisation program initiated by the Ministry of Electronics Industry.

OSRAM BACK, WOTAN OUT

Ever since 1919, lamps manufactured in Germany by the AUER/AEG/Siemens conglomerate OSRAM GmbH have had to be sold in former British Commonwealth countries like Australia under the Siemens registered brand name WOTAN,

VIDEO LINK FOR NSW GAOL

A Philips Video System has gone to gaol and NSW attorney general and minister for justice, John Hannaford, has praised this pilot video project, saying that it should result in enhanced security for the community, less chance of prisoner escapes from custody and substantial savings to the Government. The pilot video bail link project uses a private microwave system between the Metropolitan Remand Centre at Long Bay Gaol and the Supreme Court in Sydney's city centre.

Seated at Long Bay Gaol's video bail link desk is Attorney General and Minister for Justice, John Hannaford. With him are Alain Pilot (left) of Philips S&I and Bernie Marden, Project Manager, Department of Courts Administration.

The project is testing the use of video conferencing in court proceedings for bail applications.

Supplied and installed by Philips Scientific and Industrial, it is, the minister claims, a world first in the more efficient handling of bail submissions.

The microwave link installation involves a line of sight link between the two points of 11.75km. Consulting engineers IPP Security of Melbourne designed the system and supervised its installation which involves video, audio and private communications systems.

A new courtroom was built at the Supreme Court Building to be used exclusively for bail application hearings.

Alterations were made to existing accommodation at the Metropolitan Remand Centre to provide suitable video courtroom and prisoner holding area facilities to enable the bail video link facilities to perform satisfactorily.

because the 'OSRAM' brand name was transferred in England to GEC during World War I.

However after long negotiations, GEC has now transferred their rights to the OSRAM name back to OSRAM GmbH. As a result, the Australian WOTAN Lamps has now become OSRAM Australia, with GEC Wholesale as its 'most favoured supplier'.

PROTEL SCORES HIGHLY AT CONFERENCE

The PCB CAD tools produced by Protel Technology, the former Tasmanian firm now headquartered in the USA, scored highly in a benchmark comparison held at the recent PCB Design Conference in Santa Clara, California. Protel's products came second in the comparisons, scoring higher (81) than those of PADS Software (79), OrCad (65) and Ultimate Technology (51). The highest scoring product was from Masstek Ltd (92).

Functional categories tested in the comparison included database compile, library, placement, routing, post processing, design for manufacturability and design rule checking.

The board used was a 'real world' design, with six layers and over 1000 components and nets.

Researchers at AT&T Bell Laboratories have developed a new technique for cleaning sensitive electronics boards and modules in an 'environmentally friendly' way. The system involves producing tiny pellets of dry ice (solid CO_2), which are pressurised and used to blast the surface to be cleaned, in a similar way to sand blasting. The used pellets are allowed to evaporate into the atmosphere, replacing the CO_2 used to make them in the first place.

CONTROL ROOM FOR SUB-SEA VEHICLES

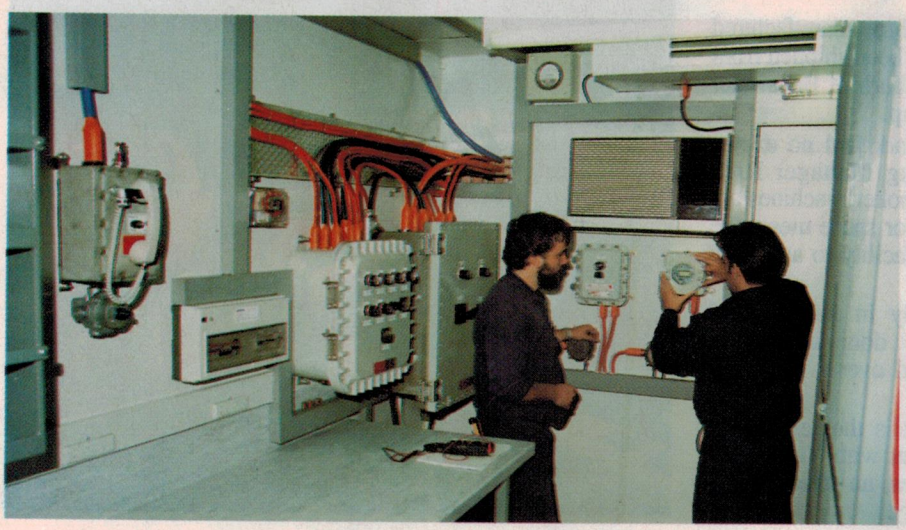
Melbourne company Nilsen Electric has proved it has the innovation and technical expertise to beat its international competitors, by designing and fabricating an award-winning transportable pressurised control room for the remote operation of sub-sea vehicles on offshore oil platforms.

Nilsen's clients in this project, a major Australian petrochemical company and Underwater Video Systems P/L, decided to see if they could gain cost advantages and improve the functional capability of the control room by developing an Australian-made system.

Nilsen responded to the task by designing and producing an innovative module, which not only satisfied the customer's requirements and was 30% cheaper than the imported version, but was also recognised with an Excellence Award in the recent Electrical Contracting Industry Excellence Awards.

The Awards organised by the Victorian chapter of the National Electrical Contractors Association (NECA), acknowledge outstanding achievements by member electrical contractors and their employees and are judged on innovation, workmanship and technical expertise.

Nilsen Electric's general manager Mr Keith Ondarchie said the award was recognition of the workmanship and dedication to quality of the technical team who designed and built the control room.



ENGENIUS ENGINEERING CONFERENCE AT RMIT

Each year Melbourne's RMIT holds an Engenius engineering conference, at which the best nine 18-month student design projects drawn from the Communications, Electronic, Digital and Software Engineering streams are presented to an audience of working engineers, university staff and students. Project development teams also prepare journal articles for the Engenius

handbook, which is an accredited journal of reference.

The conference itself is organised according to the formal IEEE conference format.This year Engenius is being sponsored jointly by Hewlett-Packard and Ericsson, and the keynote speaker is to be Rear Admiral Hammond AO, Assistant Chief of Naval Staff, Acquisitions (RAN).

STANILITE WINS $6M CONTRACT IN CHINA

Australian firm Stanilite Electronics has received funding approval for a contract worth A$6 million for the design and supply of a maritime safety system for the Shanghai Maritime Telecommunications and Navigation Aids Corporation.

Under the terms of the contract, Stanilite will be responsible for the entire project, which will ultimately result in the establishment of a Global Maritime Distress and Safety System (GMDSS) shore station servicing the Western Pacific region, GMDSS equipment for a number of vessels and a trunked radio system for port communications.

The project will be financed through Australian government concessional funding from the Australian International Development Assistance Bureau and the Export Finance and Insurance Corporation under the Development Import Finance Facility scheme.

GMDSS is part of a world wide drive by the International Maritime Organisation to improve safety standards in commercial shipping. It will provide shipping operators and maritime authorities with a high quality, internationally standard communications system that will improve responsiveness to shipping incidents, minimising loss of life and environmental damage.

Stanilite's contract calls for the specification, design, supply, installation and commissioning of the shore system, which is to be fully operational by December 1995. Stanilite will also supply shipboard GMDSS equipment for a significant number of the 200 vessel fleet operated by Shanghai's Bureau of Marine Transport Authority.

Stanilite will manage the entire project, and will place Australian engineers in Shanghai to supervise all aspects of the project.

SMALLER 64Mb DRAM RESEARCH

IBM Corporation, Siemens AG and Toshiba Corporation have announced plans to design and develop a second generation of 64 megabit memory chip.

The effort will capitalise on first generation 64Mb chip technology developed independently by Toshiba and an alliance between Siemens and IBM, and a 256Mb technology developed by IBM, Siemens and Toshiba in an alliance announced in July 1992.

The new generation of dynamic random access memory devices will be smaller than the first generation of 64Mb chips just becoming available on a sample basis from a number of manufacturers. The smaller chips will be made possible by use of the inherent capabilities of IBM's, Siemens and Toshiba's first generation technology, and by early use of some advances made by the three companies for the 256Mb alliance. The chips will provide the user reduced footprints for high density memory applications.

The new chip will be developed at IBM's Advanced Semiconductor Technology Centre in East Fishkill, New York, and at IBM's laboratory in Essex Junction, Vermont.

LUCAS EXPANDING IN ASIA PACIFIC

Lucas Control Systems Products, a group which combines the resources of several Lucas business units, has become recognised by a leading supplier of machine operation and control systems. Now the group plans to extend those activities into the Asia Pacific region, aiming to become a major supplier of world class high tech products fully supported through a network of local distributors.

Key markets served by the group's products are end users, OEMs and systems integrators, in aerospace and military, industrial automation, telecommunications, medical and laboratory instrumentation, business machines and the automotive industry.

The group plans to support its activities in the Asia Pacific region by establishing a network of competent local distributors, fully backed by a dedicated Asia Pacific sales team. To this end, Harvey Goldman has recently been appointed as Asia Pacific Sales Manager.

Amtex Electronics has been associated with one of the group's business units, Lucas Deeco, for the past eight years. Over this period they have been success-

DATACRAFT MAKES 1000 POKER MACHINES

Right on schedule, the 1000th poker machine manufactured by Datacraft's Gaming Systems Division has been shipped from the firm's factory in the outer Melbourne suburb of Bayswater — only six months after the factory was set up.

"Our manufacturing facility at Mooroolbark had no excess production capacity," said Manufacturing Manager Rick Sample. "That combined with the fact that poker machines are big pieces of equipment and need lots of floor space meant we had to set up a special new manufacturing facility to assemble and produce the machines."

"We started to kit out the factory early in January and the first poker machines rolled out the door in March. Now just four months later, we've delivered over a thousand, high quality machines."

Production of the machines by Datacraft is the result of a technology transfer and Licencing agreement with Video Lottery Consultants (VLC) of the United States, an International leader of gaming machine systems technology.

ful in supplying the company's range of flat panel modules and controllers, touch screen terminals and industrial computers, for a wide spread of applications in the industrial, mining and aviation industries.

Jim Kuswadi, Amtex's General Manager explains, "Our success has come from the products' strength. These terminals and computers are rugged, powerful and flexible, ideal for the harsh conditions so often met now that many more industrial applications are being computerised. And with Deeco's new Windows compatible interactive screen application generator, TouchAssist II, terminal screen design is much simpler and quicker."

THREE COMBINE FOR SET-TOP DECODERS

Philips in the USA has made an agreement with TV company Zenith Electronics and video conferencing specialist Compression Labs to develop and market technology for interactive television services.

Specifically, the three companies will develop and market TV set-top decoders for both digital and analog networks, so that such services as video-on-demand, video games, and home shopping can be accessed, complete with two way interactive communication.

"Our extensive global engineering, marketing, manufacturing and support infrastructures, together with those of Zenith and Compression Labs, make the group a powerhouse that understands what consumers and network providers need in this emerging business," said Bill Kennedy, senior vice president of Philips Digital Video communication system.

Under the agreement, announced in New York, a broad family of set-top devices, ranging from analog to hybrid digital/analog, to all digital designs will be offered by the group.

They will incorporate MPEG-2 (Motion Pictures Expert Group) digital decoder technology from Philips and Compression Labs and vestigial sideband transmission and real time two way technologies from Zenith.

The digital decoders will be compatible with video servers currently under development by a number of manufacturers, including Oracle, IBM, Digital, and Hewlett-Packard. They will also be compatible with Compression Labs' MPEG-2 encoders and Zenith's head-end equipment, including analog scrambling systems and digital VSB modulators.

As digital building blocks are incorporated into a new generation of television sets, the decoders themselves are expected to become less expensive, smaller 'set-back' boxes.

ABC INSTALLS SATELLITE NETWORK

As part of a nationwide satellite receiving system valued at $1.8 million, the ABC is installing a satellite receive earth station in each capital city to substantially reduce the satellite costs for their network.

As part of this network, a large antenna supplied and installed by Scientific-Atlanta Australia was recently hauled into position on top of the ABC administration building in Harris Street, Ultimo.

Previously Scientific-Atlanta had supplied and installed large earth station antennas for the ABC in Darwin, Adelaide, Hobart, Perth, Canberra and Sydney. Brisbane and Melbourne earth stations were installed in June.

The antennas being installed have a performance suitable for transmitting satellite signals as well as receiving.

The Sydney, Adelaide, Hobarth, Perth and Canberra stations have been engineered for the Ku band Optus satellites whereas the Darwin earth station was engineered for the C Band Palapa satellite, essentially to transmit ABC signals out of Australia to Pacific Islands and Asian countries on the ATVI (Australia TV International) network.

AT&T AUST SIGNS $104M AGREEMENT

AT&T Australia has signed a Fixed Term Arrangement (FTA) with the Federal Government involving more than $104 million in industry investment and development.

The four year FTA is built upon three planks — infrastructure investment in export-oriented, future focused manufacturing; investment in a research and development facility in Australia and continued development of strong partnerships with Australian firms. The FTA is the largest signed with the Federal Government since the programme's inception, and outlines $74 million in exports, $9 million in research and development and $21 million in capital investment.

Minister for Industry, Science and Technology, Senator Peter Cook has welcomed the agreement, saying "AT&T's decision to enter into a Fixed Term Arrangement demonstrates its commitment to long term industry development in Australia."

"The strategic activities being undertaken by AT&T demonstrate the high calibre of Australian industry. The Agreement will boost exports to the Asia Pacific region, lift research and development investment in Australia and create new strategic alliances with Australian companies," Senator Cook said.

"The agreement consolidates AT&T's position as a significant participant in Australian industry, one of the most dynamic and sophisticated market in the world," said Mr Chip Barton, Managing Director of AT&T Australia Limited.

"It is an arrangement that will see all of us, AT&T and the local industry, strengthen and enhance our capabilities in Australia, and from Australia into the global market. ❖

NEWS BRIEFS

- ***Hayes Microcomputer Products*** has appointed Tech Pacific Australia as an authorised distributor of its products, which include communications software and modems.
- Ian Ingleton of ***Amber Broadcast*** has been appointed to the position of Sales Engineer.
- The 19th Australian Conference on Optical Fibre Technology ***ACOFT '94*** will be held at the Southern Cross Hotel, Melbourne from Sunday, December 4 to Wednesday December 7, 1994. For further information contact IREE Society, PO Box 79, Edgecliff 2027; phone (02) 327 4822.
- ***A two day training course called Maximising Windows*** will be conducted by Independent Information Technology Training at Sydney, 17-18 November 1994 and Melbourne, 7-8 November 1994. For more details phone (02) 252 2844.

'Hands-on Review:

HIGH QUALITY SOLDERING STATION

Dick Smith Electronics has just expanded its range of soldering tools with the addition of a 'high end' temperature controlled soldering station: the Hakko model 926.

The soldering tools of Japan-based Hakko Corporation have become well-respected and widely used around the world, particularly in professional electronics circles. That they're not as well known here in Australia, as yet, is perhaps due to limited marketing and availability rather than any lack of reputation. Happily they now seem likely to become widely used here too, as a result of Dick Smith Electronics having decided to stock them.

At present DSE seems to be stocking only the one Hakko model, the 926 soldering station. But hopefully if these go well, the firm may be encouraged to stock other models in the very comprehensive Hakko range.

The 926 soldering station combines Hakko's model 900M 24V/50W iron, with a transformer and temperature control base unit rated at 24V/60W.

Despite its relatively high power rating, the model 900M iron is quite compact and light in weight. It measures only 190mm long, and weighs a modest 45 grams. A ceramic heating element is used inside the plated tip, to ensure reliability, with an integrated temperature sensor for the feedback control system. A very flexible silicone rubber 'burn proof' cord is used to connect it to the base unit, via a polarised five-pin plug and socket fitted with a secure locking ring.

An important characteristic of any soldering iron, when you're working on delicated modern circuitry, is its insulation resistance. Here the 900M iron is well rated, with a specified resistance of over 300M at 400°C and over 50M at 480°C (tested at 500V DC). The leakage voltage between iron tip and ground is also rated at less than 0.6mV, which no doubt assumes that the iron is well maintained and the metal surfaces (tip, barrel etc.) kept clean.

The base unit is solidly made, measuring 200 x 125 x 120mm and weighing 1.5kg. It's fitted with a power on/off switch, an iron thermostat control with a range of from 200 - 480°C (392 - 896°F), and an LED indicator to show when heating is taking place. The idling temperature control accuracy is rated at +/-0.5°C (+/-0.9°F).

The iron holder provided with the base is also sturdily made, from 1mm formed sheet metal with generous ventilation slots. It is designed to allow fitting to either side of the base, as desired. There are three separate parts: a support piece which fits into mating slots on either side of the base, the holder itself, which is symmetrical and fits to the support piece via a thumbscrew, and a moulded bayonet-fitting receptacle which can fit to either end of the holder to support the iron at the end of the handle.

At the front of the base, apart from the 'control panel' and the iron connector, there's a moulded tray into which fits a stainless steel insert and a tip-cleaning sponge (with a slot in the centre, to assist in rapid water absorption). The front of the stainless steel insert is also extended, to form a tip scraping lip and collection tray for excess solder.

At the rear of the base there's the mains cord entry, and a flush-fitting 1A cartridge mains fuse.

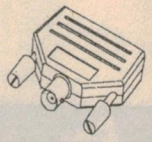
Checked out on our workbench, the sample 926 station shown gave a good account of itself. It reached the set temperature quite rapidly after switch-on, and also regained the temperature within a few seconds of making typical solder joints. Even with the control set for idling at 275°C — only just above the melting point of 60/40 solder alloy — we were able to make joints bonding 3mm copper braid to a large copper area on a PCB. This is a fairly stiff test for lightweight irons, and is an indication that the iron has plenty of thermal reserve for all normal electronic work.

The Hakko model 926 soldering station is now in stock at all company-owned Dick Smith Electronics stores, and available also via many resellers. Listed as Cat. No. T-3800, it is priced at $259. Four different replacement iron tips are also available, each priced at $10.95. (J.R.) ❖

LOW COST VIRTUAL INSTRUMENTS FOR PCs

The PICO Technology range are unique low cost data acquisition products for IBM PCs and compatibles. Installed in seconds, they simply plug directly into either the serial or parallel port. Each device comes with PicoScope Software (Oscilloscope, TRMS Voltmeter, Spectrum Analyser), PicoLog (Advanced Data Logging software) or both. Also includes C, Pascal and basic drivers to develop your own software.

ADC-10



- Single channel 8 bit Inputs, 0-5V
- Up to 24kHz Sampling Rate
- Includes PicoScope Software

ADC-10 $126 + TAX
ADC-10 with PicoLog $152 + TAX

ADC-11

- 11 Channel, 10 bit Inputs, 0-2.5V
- Up to 15kHz Sampling Rate
- Includes PicoScope Software

ADC-11 $219 + TAX
ADC11 with PicoLog $245 + TAX

ADC-12

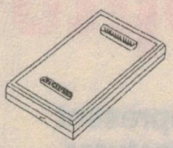
- Single Channel, 12 bit Inputs, 0-5V
- Up to 18kHz Sampling Rate
- Includes PicoScope Software

ADC-12 $219 + TAX
ADC-12 with PicoLog $245 + TAX

Typical applications:

- *Oscilloscope*
- *Voltmeter*
- *Spectrum Analyser*
- *Audio Sampling*
- *Chart Recorder Emulation*
- *Temperature Measurement*
- *Pressure Measurement*
- *Chromatography*
- *Research & Teaching*

ADC-16



- 8 Channel, 16 bit Plus Sign Inputs
- +/- 2.5V Input Range
- Includes PicoScope Sofware

ADC-16 with PicoLog $298 + TAX

ADC-100 HI-SPEED

- Dual Channel 12 bit Inputs
- Up to 120kHz Sampling Rate
- ±200mV to ±20V, Inputs, AC/DC
- 2 x 1MΩ Inputs, BNC connectors
- Includes PicoScope & PicoLog

ADC-100 HI-SPEED $495 + TAX

Emona Instruments

NSW (02) 519 3933 **VIC (03) 889 0427**
QLD (07) 397 7427 **WA (09) 961 4200**

Also available from:
SA Wavecom (08) 331 8892 **WA Hinco** (09) 244 2777 **TAS GHE** (002) 31 6533

READER INFO NO. 17

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28TH SEPTEMBER – 1ST OCTOBER, 1994

WEDNESDAY SEPTEMBER 28	10AM - 8PM
(Business Only Day)	
THURSDAY SEPTEMBER 29	10AM - 8PM
FRIDAY OCTOBER 30	10AM - 9PM
SATURDAY OCTOBER 1	10AM - 6PM

ADMISSION: $7

BUSINESS ONLY DAY WEDNESDAY 28TH SEPTEMBER

For more information contact James Curtain at Queensland Exhibition Services. PO Box 3232, South Brisbane MAC QLD 4101. Ph (07) 846 4777 Fax (07) 846 2811

READER INFO NO. 18

Special feature:

The latest equipment in Opto-electronics

Alcora to represent opto manufacturer

Alcora has been appointed as representative for opto device manufacturer Three-Five (IIIV) Systems in Australia. The product families include numeric, alphanumeric and bargraph integrated displays with on-board drivers, application specific integrated displays (ASID) and industry standard optocouplers.

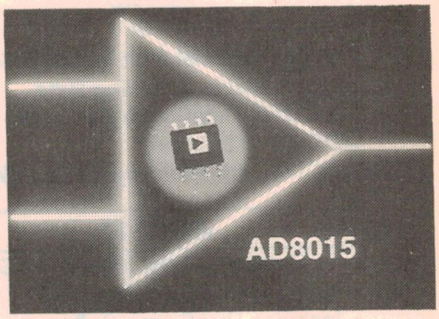
Other products are visible lamps, digits, light blocks and multiple-digit displays, infrared emitters and detectors. Three Five Systems also offer standard and custom LCD modules, with full factory support.

For further information circle 216 on the reader service coupon or contact Alcora, Unit 1, 31 Smith Street, Capalaba 4157; phone (07) 245 2941.

200MHz amplifier for optical networks

Analog Devices has released the AD8015, the first silicon transimpedance amplifier to meet the bandwidth, noise and sensitivity specifications of 155Mbps data links. The AD8015 is suited to applications such as ATM LANs or fibre-to-the-home.

The AD8015's 200MHz bandwidth allows data rates of up to 300Mbps NRZ, with a sensitivity of -36dBm at 155Mbps. The high gain and low noise of the AD8015 allows the receiver to detect weak input signals. These specifications supply 2dB headroom over the SONET OC-3 specification or a comfortable 5dB over FDDI requirements. With a typical bandwidth of 100MHz, previous generations of



silicon transimpedance amplifiers are too slow for these applications, forcing engineers to use more expensive gallium arsenide integrated circuits.

For further information circle 202 on the reader service coupon or contact NSD Australia, 205 Middleborough Road, Box Hill 3128; phone (03) 890 0970.

Laser profiler handles 9mm diameter beams

This product, from Melles Griot, consists of a measurement head that plugs into a card that fits in a PC. The software uses the graphics capability of the PC to provide 2D and 3D profile displays. It also has a mouse operated interface.

By simultaneously measuring the width, profile, position, power and power noise spectral density of a CW laser beam, the unit forms a single test station

A novel feature of the Super Beam-Alyzer is its ability to analyse the power noise and modulation spectrum of a laser in the 100Hz to 6MHz frequency range.

Enhanced spatial resolution is also provided with seven scanning knife edges providing high resolution 3D images of the beam using tomographic reconstruction techniques. This increases the applications for beam analysis to laser beams with more complex distribution than purely Gaussian. Beam powers from 10 microwatts to one watt are handled with a filtering system that places the neutral density filters after the scanning knife edges to eliminate distortion.

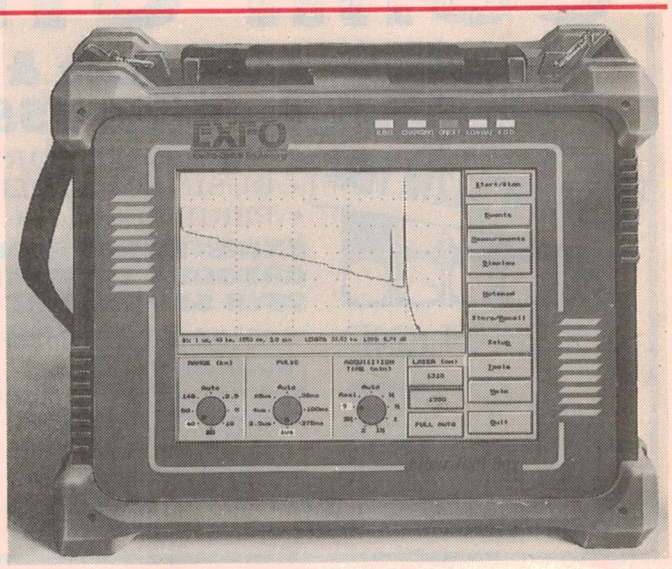
Mini OTDR sets new standards

The new Fibre Tool Box (FTB) from EXFO Electro-Optical Engineering has a touch screen, full OTDR (optical time domain reflectometry) features, a power meter, visual fault locator and a DocuNet trace management system. Exfo claim this makes the FTB the world's most advanced mini OTDR.

All OTDR operations are done by touching the screen with any blunt pointing device. Zooming in on an event is as simple as touching directly on the desired event, then zooming. The high resolution screen is one of the largest in the industry, and features a user-friendly control layout.

Other tools that can be put in the Fibre Tool Box include a power meter, CW source or visual fault locator, creating a portable, field ready test unit. Applications include fault location, fibre installation, construction, maintenance and commissioning, or anywhere fibre is being used or needs to be tested.

For further information contact EXFO, 465 Godin Avenue, Vanier, Que., Canada GIM3G7; phone (418) 683 0211.



A wide variety of applications and industries can use beam profiling to qualify incoming laser assemblies, develop beam delivery systems, collimate beams and apply actual parameters to the beam models.

For further information, circle 215 on the reader service coupon or contact Spectra-Physics, 25 Research Drive, Croydon 3136; phone (03) 761 5200

New red-light laser diode

Toshiba has announced it will start worldwide marketing of a new red-light semiconductor laser diode specially developed for optical disk systems. A shorter wavelength and higher optical output power significantly increases the storage capacity of optical disk systems.

The new TOLD9151MB operates at a wavelength of 685mm with an output power of 50 milliwatts. Its shorter wavelength produces a smaller read/write spot on the disk surface than the 780nm wavelength lasers currently used in optical disk systems. This smaller spot size allows almost double the volume of information to be stored on the same size disk.

The laser uses a new isolated chip configuration which allows system design with either a position or a negative laser drive voltage. Conventional red-light laser diodes have previously been limited to operation with a negative drive voltage.

For further information circle 203 on the reader service coupon or contact Toshiba Australia, PO Box 350, North Ryde 2113; phone (02) 887 3322.

Optical links for E-field sensors

IFI Inc has released the LMT series of light modulators and transmitters, as companions to IFI's extensive range of RF field sensors.

IFI have a comprehensive range of RFI/EMC test equipment, including broadband high power amplifiers, E-field sensors to 40GHz and radiation hazard monitors, E-field generating antennas, test chambers and full automated test systems.

Of particular interest in Australia are the IFI range of RF field sensors, as there is an increasing awareness of the possibility of human biological effects caused by electromagnetic fields.

While there is a great deal of research, investigation and quantifying of this data yet to be done, enough work has been done to develop standards for the exposure of personnel to electromagnetic energy. IFI has been making for a number of years a direct reading broadband field strength meter which is calibrated in volts per metre. The EFS Series respond to the electric component of the field.

The new LMT light modulator transmitter is an accessory unit to the EFS Series E-Field Sensors. It attaches directly to the underside of the E-Field Sensor and converts the voltage output of the sensor to an optical signal which is coupled away from the field under test by means of an electrically non conducting fibre optic 'light pipe' for remote reading.

Like the EFS Series, the LMT is completely self contained and operates on rechargeable NiCad batteries. It produces telemetering light flashes by means of a light emitting diode modulated by a stable voltage-controlled oscillator. These light flashes may be counted for digital use or applied to a frequency-to-voltage converter for analog indication.

For further information circle 201 on the reader service coupon or contact Wedgetail Technologies, 604/2 Help Street, Chatswood 2067; phone (02) 415 3944.

OPTO ELECTRONICS

Automatic laser diode power controller

Toshiba has released what it claims is the world's first one-chip auto power controller (APC) able to handle output power of a frequency of 100MHz, the minimum frequency for laser printers and optical disk drives.

The optical units of laser printers and optical disk drives incorporate laser diodes. These diodes are small and highly efficient and their operation can be directly controlled by changing the power input frequency. However, they are also vulnerable to fluctuations in temperature, which can damage output quality. The APC maintains the quality of the output by constantly observing and stabilising output from the diode. Until now, an APC has comprised a number of discrete semiconductors. Toshiba's TA8546FN takes up only 1/0 - 1/50 the area required for this type of APC.

Among the circuits integrated in the device are two amplifiers that boost the modulating signal to control output and a driver that converts the modulating signal into current.

Safe operation is assured by a current limiting circuit which prevents destruction of the laser circuit by power surges. The APC warns when this circuit is in use and cuts power.

For further information circle 204 on the reader service coupon or contact Toshiba Australia, PO Box 350, North Ryde 2113; phone (02) 887 3322.

Barcode scanner is intrinsically safe

UK based Spectra-Tek has released an intrinsically safe (IS) hand-held barcode scanner.

The IS 3000, which is based on Symbol's LS 3000 scanner, is a rugged industrial scanner supplied with an intrinsically safe decoder and a barrier for interfacing with host computers, PCs and control systems located in safe areas. The scanner, which uses a class III A visible laser diode, is operated by a dual pressure trigger located within the pistol grip. Initial pressure causes a bright narrow-width scan to be emitted, enabling the operator to aim the gun accurately. Additional pressure activates the full width scan and the reading process.

A 1.8 metre flexible coiled cable connects the scanner to the local IS 3000 scanner decoder driver (SDD). The SDD unit can auto discriminate all popular barcode symbologies and assembles the resulting code into serial ASCII format for transmission to a computer or terminal.

For further information circle 205 on the reader service coupon or contact MTL Instruments, 13-17 Sorbonne Crescent, Canning Vale 6155; phone (09) 455 2994.

Thermal video system

The Flir 7300 Thermal Video System operates by converting infrared radiation, in the two to 5.6 micron region, from a device under test into a video image.

This image is then displayed on a colour monitor, using 128 different colours for the temperature span selected. The temperature range covered is from -20 to 1500°C and is intended for use in areas where thermal contact is inappropriate.

The Flir 7300 comprises three separate parts, one the infrared camera, which is electrically cooled; two the processor; and three the display unit. All units can be operated from either battery or 240 volts mains supply. The batteries can be carried in a waist belt for portable hand-held operation.

This display unit is a combined high resolution LCD matrix colour panel and VHS recorder which uses standard cassettes. All information shown on the screen can be recorded for later comparison and editing. Additionally a full colour video printer is supplied to provide the user with an immediate hard copy of the on-screen results.

Precise temperature of specific points on the screen can be obtained by the use of a mobile cursor. Similarly the average temperature inside an on-screen box can be readily obatined. Resolution is 0.1°C and accuracy is given as +/-2°C. An Auto set-up facility allows even the first time user the opportunity to obtain results quickly.

For further information on the Flir TVS 7300 contact your nearest Tech Rentals office, or ring (03) 879 2266. ❖

Remember It's Always Wood for Chips!

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The TP5088 is a CMOS device providing low cost tone-dialling capabilities in microprocessor controlled telephone applications. 4-bit data is decoded directly without any need for conversion. Features direct µP interface, latches for binary data. Generates 16 standard tone pairs. On-chip oscillator. Low power stand-by mode.

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LM1875 20Watt Power Audio Amplifier

The LM1875 delivers 20W in to a 4 or 8Ω load using ±25V supplies. Using an 8Ω load with ±30V over 30W can be achieved. Requires a minimum of external parts. See project in Dec 93 Silicon Chip.

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READER INFO NO. 22

NEW PRODUCTS

Radio direction finding system

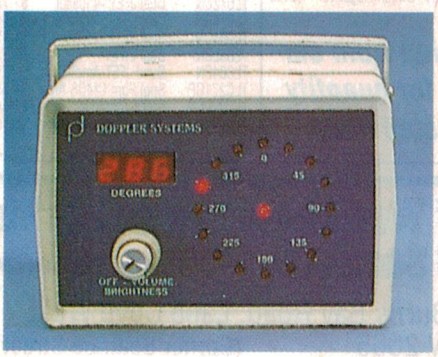
Doppler Systems has announced an expanded line of its radio direction finding systems which will cover frequencies up to 1GHz. The new 5000 series provides improved accuracy as well as a wider frequency range using a remote RF summing circuit. Typical accuracy is +/-5°. A wide range of antennas is offered to cover frequencies between 50 and 100MHz.

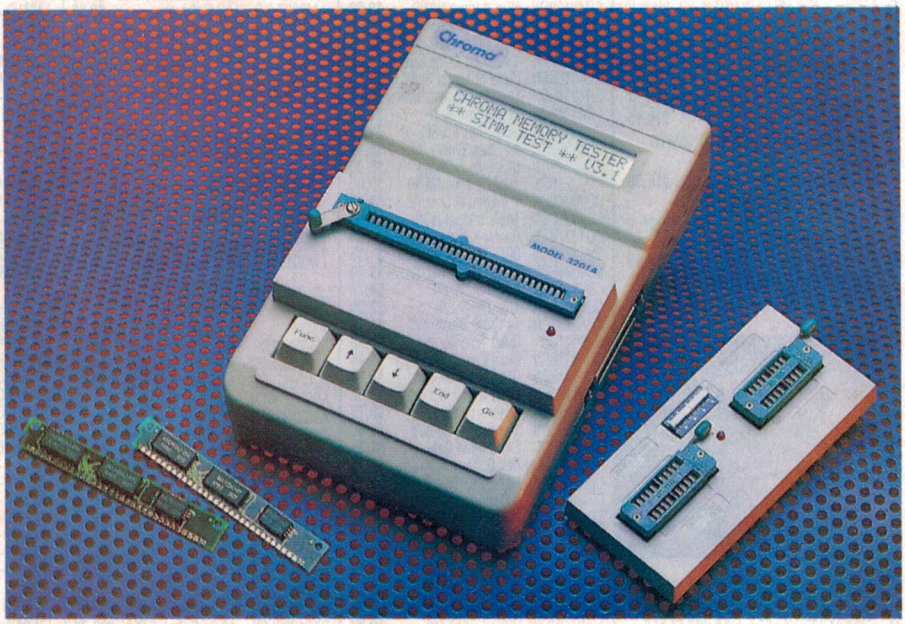
When used with a narrow band FM receiver, the system works in a quasi-Doppler mode. Four antennas arranged in a square pattern are combined in a way that simulates a single antenna rotating in a circle. As the simulated antenna moves toward the RF source, the apparent frequency increases, and as the antenna recedes from the source, the apparent frequency decreases. This up-down (Doppler) shift is detected by a narrow-band FM receiver and can be heard as a 300Hz audio tone. The direction finder measures the phase angle of this tone to display the bearing. The quasi-Doppler mode is recommended for tracking unmodulated carriers, standard NBFM signals and AM signals.

A typical installation consists of a processor/display unit, an RF summer unit and one or more antennas. A receiver is also required. Good quality scanners are generally used although transceivers, service monitors and spectrum analysers may also be used, provided care is taken to not transmit through the direction finder.

Four processor/display models are available. DDF5001 displays the bearing with 16 high intensity LEDs arranged in a circle. A three digit display is added on the DDF5002 for 1° resolution. Models DDF5003 and 5004 provide an RS232C serial interface and synthesised speech, respectively.

For further information circle 246 on the reader service coupon or contact T&M Instruments, 17 Whinham Street, Fitzoy 5082; phone (08) 269 1561.





DRAM SIMM/SIP tester

The Chroma-3201A is a portable instrument capable of testing all types of DRAM memory devices, such as 30-pin, eight or 9-bit SIMM, SIP memory modules with 64K, 256K, 1M, 4M or 16M capacity, IBM PS/2 72-pin 32 or 36 bit SIMM memory modules with 256K to 16M memory, and all types of single DRAM chips. Adaptors that test SIMM, SIP, DIP, SOJ, PLCC, TSOP and other non-standard memory modules are available.

Using a powerful high speed processor, the Chroma-3201A tests every memory cell with a wide variety of data patterns. It is capable of measuring and displaying the module size, and access time (speeD). In the bit by bit mode, it provides individual speed ratings and other related information for each chip.

The tester is user friendly and the adaptors can be installed and replaced quickly. The LCD display shows clear instructions and test results. Additionally the printer interface port can be used to print test reports.

For further information circle 241 on the reader service coupon or contact Nucleus Computer Services, 9B Morton Avenue, Carnegie 3163; phone (03) 569 1388.

Fully autoranging DSO from Fluke

Fluke has announced a first of its kind digital storage oscilloscope (DSO), which features fully autoranging attenuators and timebase. The new PM 3394A CombiScope oscilloscope is part of the CombiScope family of instruments that combine digital storage and an analog oscilloscope.

The autoranging innovation is part of Fluke's commitment to make test instruments easier to use. Fully autoranging attenuators and timebase enhance, and may even supersede Autoset, a feature on most oscilloscopes. Autoset operates only when a button is pressed, while autoranging operates continuously on both the attenuators and timebase to maintain an optimal signal display, even when the signal changes.

Electronics troubleshooters will particularly benefit from the autoranging facility. The combination of digital storage and an analog scope in one unit provides versatility with autoranging greatly enhancing the speed of operation.

Solder rework station

The new Weller DS1000D portable soldering/desoldering rework station combines the Weller EC electronic temperature control station and the desoldering power of the DS650 station.

The unit features: mil - spec; zero switching; proportional control; operating temperature control from 177°C to 454°C; non-burn rubber cords and vacuum lines; and full electrical authority approval.

Soldering and desoldering functions are independent, so there is no need to run both when only one is required. The built in vane pump provides a rapid vacuum build up to minimise tip cooling and ensures successful removal of the most difficult components. A full range of desoldering tiplets featuring stainless steel liners and iron plated working surfaces is available.

The DS1000D can also be purchased as a power unit with an EC1201 soldering iron/pencil and DS1201 desoldering unit as standard equipment. Other soldering pencils can be purchased which are compatible with the system, to enable customisation of the station to the user's needs. The station is assembled and serviced in Australia.

For further information circle 244 on the reader service coupon or contact Cooper Tools, PO Box 366, Albury 2640; phone (060) 58 0300.

A TM5320 digital signal processor running at 40MHz ensures that the PM 3394A has an almost instantaneous response to signal changes, and three processors are dedicated to different instrument functions. This means that mathematics and autoranging features do not slow down other instrument parameters, such as the response speed to changes in control panel settings.

The new series consists of two four channel models with 100MHz and 200MHz bandwidths (PM 3384A and PM 3394A), and two 2+2 channel models, with 100MHz and 200MHz bandwidths (PM 3382A and PM 3392A).

All models have a serial interface for hard copy and PC communications as standard. A GPIB/IEEE 488.2 interface is an option.

For further information circle 242 on the reader service coupon or contact Philips Test and Measurement, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.

Force sensor has own amplifier

PCB Piezotronics has released an improved series of piezoelectric ring style force sensors. These quartz force rings are commonly used in manufacturing processes to monitor dynamic forces. Typical applications include compression/tension press monitoring, balancing, forming, fatigue testing, predictive maintenance and quality control.

The series 201 quartz force rings are designed for measuring dynamic compression and tension forces over a dynamic range from 0.0002 to over 100,000 pounds. Rigidity comparable to steel provides long term stability, ruggedness, and broad frequency response. Made of welded, hermetic seal construction, eleven sensor designs are available which can be incorporated into controlled laboratory testing or harsh, permanent mount factory environments.

An internal microelectronic amplifier is incorporated into each design. This amplifier converts the high impedance charge output to a low impedance voltage signal which can be transmitted over long cables. For higher temperature applications, rings without internal electronics are available.

For further information circle 243 on the reader service coupon or contact M.B. & K.J. Davidson, 17 Roberna Street, Moorabbin 3189; phone (03) 555 7277.

Ceramic resonators with built-in capacitors

Integrity Technology Corporation has announced a new line of ceramic resonators with built in capacitors. The frequency range is from 2MHz to 12MHz.

Typical built in capacitance are 30pF capacitors connected at the centre pin for standard TTL circuits. Other capacitance values are available including 100pF for CMOS circuits.

Frequency tolerance is +/-0.3% at ambient temperature. Operating temperature range is from -20°C to +80°C. Frequency tolerance due to aging is +/-0.3% per year for 10 years.

For further information contact Integrity Technology, 1400 Coleman Avenue, Santa Clara, CA 95050; phone (408 262 8840.

New RF counter from HP

Hewlett-Packard has announced a low cost RF counter that lets engineers make accurate high frequency measurements quickly and easily.

This new addition to HP's family of bench top counters is priced at $2450 and features an enhanced, intuitive user interface designed to simplify and speed frequency measurements. Engineers can access basic measurement functions with the push of a single button, and a self guided, shallow menu tree permits access to other commonly used functions.

For applications that demand frequency resolution, the new counter provides 10 digits of resolution per second. A digit blanking function lets users eliminate unnecessary digits to read measurements quickly.

Features include up to 225MHz bandwidth, optional high frequency measurements up to 3GHz, built-in statistics and math functions, and a standard RS-232 (talk only) interface that provides printer support or data transfer to a computer through a terminal emulation program.

For further information contact Hewlett-Packard on phone (02) 13 1347. ❖

Electronics Australia

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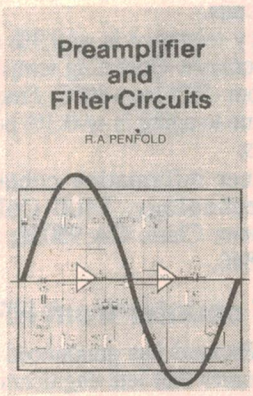
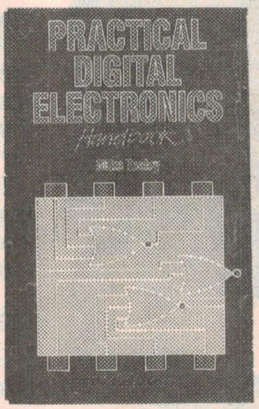
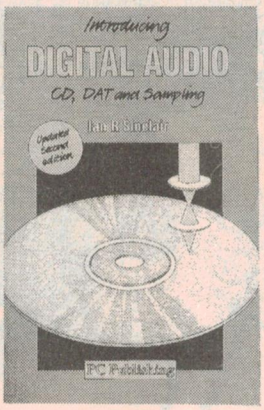


Preamplifier and Filter Circuits
This book provides circuits and background information for a range of preamplifiers, plus time controls, filters and mixers. The circuits described are simple and previous experience of electronic project construction is not needed.
CODE: BP 3090 PRICE: $11.00



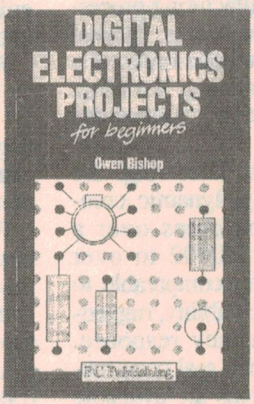
Practical Digitial Electronics Handbook
This book introduces digital circuits, logic gates, bistables and timers as well as microprocessers, memory and input/output devices. It will prove invaluable to anyone involved with the design, manufacture or servicing of digital circuitry.
CODE: PC 1004 PRICE: $22.95



Introducing Digital Audio, CD, Dat and Sampling. - Second Edition:
This book bridges the gap for the technician and enthusiasts who have worked with audio circuits. It includes oversampling methods and bitstream techniques and technical terms.
CODE: PC 1007 PRICE: $22.95

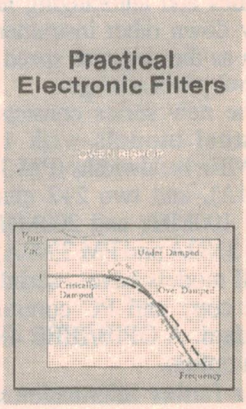
Computers and Music - An Introduction:
This book explains how to simply set up your own computer music studio. It covers the basics of computing, running applications programs, wiring up a MIDI system plus everything about hardware and the programs.
CODE: PC 1006 PRICE: $27.95

Practical MIDI Handbook
Refers to the powerful capabilities of MIDI and how to exploit it, with no knowledge of electronics or computing. It reviews the latest developments in MIDI covering keyboards, drum machines, sequences, mixers, guitars etc.
CODE: PC 1002 PRICE: $22.95

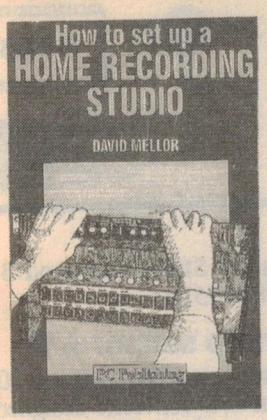


Digital Electronic Projects for beginners
This book provides simple, yet detailed instruction on practical projects. Covering instrumentation to home security plus circuit diagrams, this reference book also offers 'fun' projects for newcomers to electronic construction.
CODE: PC 1011 PRICE: $19.95

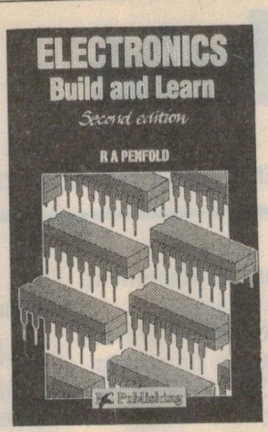
Synthesizers for Musicians
Written especially for musicians, this book explains how to get the best from your synthesizer or sampler. If you want to go beyond using the factory presets or the random poking of buttons, then this is the book for you.
CODE: PC 1003 PRICE: $19.95



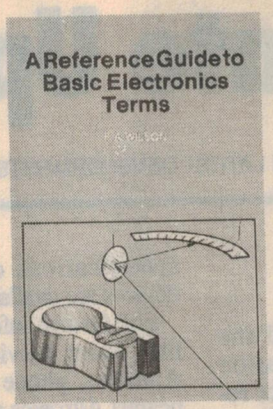
Practical Electronic Filters
Practical Electronic Filters explains in a simple form, the understanding of how to work a filter. It presents projects to apply in and around the home, including diagrams that are suited to the beginner and a more advanced constructor.
CODE: BP 2990 PRICE: $13.00



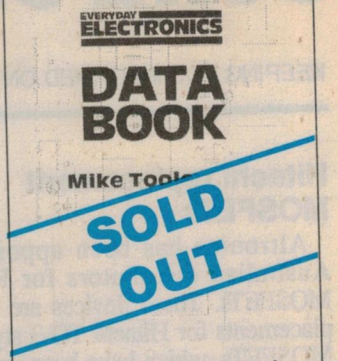
How to set up a home Recording Studio
If you have a studio at home or are about to set one up, this book is for you! It describes the setting up of an 8 to 16 track studio with an outline of the musical and recording gear needed.
CODE: PC 1009 PRICE: $22.95



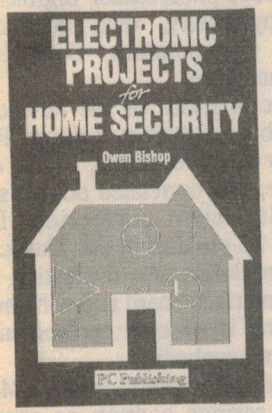
Electronics - Build and Learn
This book is the perfect balance of theory & practice. It introduces common electronic components and how they are built into useful circuits. An essential for the beginner, providing practical tests and experiments.
CODE: PC 1008 PRICE: $19.95



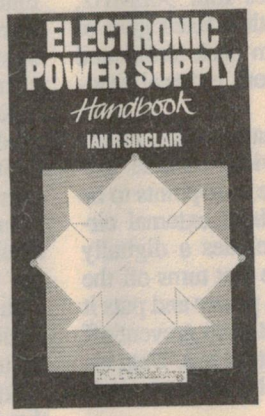
A Reference guide to Basic Electronic Terms
A comprehensive A to Z guide of electronic terms. This book chooses and explains some of the more important fundamental terms (over 700), making the explanations easy to understand and avoiding high level mathematics.
CODE: BP 2860 PRICE: $16.00



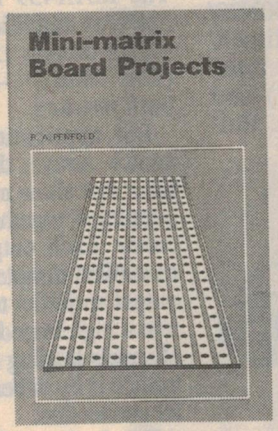
Everyday Electronics Data Book
This book is an invaluable source of information of everyday relevance in the world of electronics. A must for everyone involved on electronics who wants to put theory into practice.
CODE: PC 1012 PRICE: $27.95



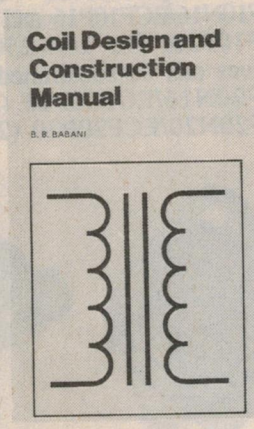
Electronic Projects for Home Security
This book deals with the many aspects of home-security and how to construct your own security system. It covers the latest in technology, whilst remaining simple and reliable in its instruction.
CODE: PC 1010 PRICE: $22.95



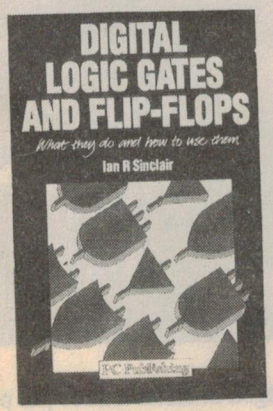
Electronic Power Supply Handbook
This book covers the topic of electronic power supplies, including batteries, simple AC supplies, switch-mode supplies and inverters. Subjects dealt in detail are devices, their operating principles and typical circuits.
CODE: PC 1001 PRICE: $23.95



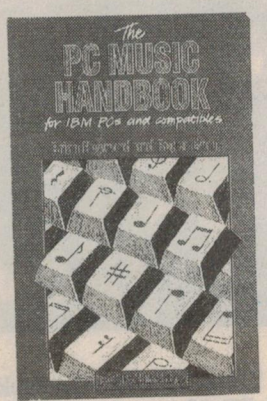
Mini Matrix Board Projects
This book provides you with 20 useful and interesting circuits, all of which can be used on a mini matrix board, which is just 24 holes by 10 copper strips.
CODE: BP 9900 PRICE: $6.50



Coil Design and Construction Manual
A unique book for both the professional and home constructor on 'How to Make' your own R.F., I.F., Audio and Power coils, chokes and transformers etc.
CODE: BP 1600 PRICE: $6.50



Digital Logic Gates and Flip-Flop
Intended for enthusiasts, this book aims to provide a firm understanding of gates and flip-flops thoroughly and from the beginning. It is for the user who wants to know more than a few rules of thumb about digital circuits.
CODE: PC 1013 PRICE: $26.95



The PC Music Handbook
This book takes the reader through the creative possibilities of the personal computer. Full of practical tips on equipment plus explanation of sequencing, sampling and notation.
CODE: PC 1005 PRICE: $27.95

HOW TO ORDER

To order, simply fill in the coupon, remembering to include the code numbers and $5.00 postage and handling. If the coupon is missing, write down the names, code numbers and prices of the books you require. Include your name, address, phone number, plus cheque, money order or credit card details (card type, card number, expiry date and signature) and send it all to Federal Publishing, Reply Paid No. 3, PO Box 199, Alexandria, NSW 2015.

Please allow at least 40 days for delivery, and please sign all orders.

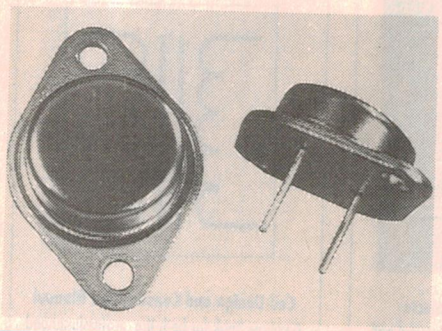
Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Hitachi replacement MOSFETs

Altronics has been appointed the Australian distributors for Profusion MOSFETs. These devices are direct replacements for Hitachi TO-3 style lateral MOSFETs, which have been used extensively in audio amplifiers.

However, Hitachi have ceased manufacturing these devices, which included the 2SK134/2SJ49 (160V/125W) and 2SK176/2SJ56 (200V/125W) eight amp complementary pair MOSFETs. Their equivalents are types ECF10N16/ECF10P16 and ECF10N20/ECF10P20. The 16A 250W Hitachi devices can be substituted with types ECF20N16/ECF20P16 (160V) and ECF20N20/ECF20P20 (200V). Full specifications of these replacement devices are available on request.



For further information circle 273 on the reader service coupon or contact Altronics, phone (09) 328 1599 or the nearest Altronics retailer.

100MHz switches

The MAX458/MAX459, 8x4 video crosspoint switches from Maxim are monolithic ICs designed to replace multiple switches, amplifiers and logic. The MAX458 includes four digitally controlled, 100MHz, unity-gain output buffers. The MAX459 includes four 900MHz, 300V/us amplifiers with a fixed gain of +2 for driving 150 ohm back terminated cable directly — without external feedback resistors.

For applications that require larger switch arrays, the devices include features that allow multiple crosspoints to be paralleled together without external circuitry. Each output includes a digitally controlled disable mode that turns off the output amplifier to save power and puts it into a high impedance state to prevent off channels loading the output bus. Data interface is by either a 16-bit serial or parallel connection.

For further information circle 272 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

20-bit photo sensor A/D

Burr-Brown's new DDC101 is a 20-bit, current input A/D converter designed for low level sensors such as photodiodes. It combines the functions of a switched capacitor integrator with a D/A converter, a comparator, a digital filter and a programmable gain amplifier all on a single monolithic chip.

The device suits precision instrumentation and process control applications including direct photosensor digitisation, infrared pyrometry, data acquisition systems, CT scanner DAS, and chemical analysers.

Key specifications of the device include: 20-bit resolution, 1.6ppm RMS digital filter noise reduction, 15kHz conversion rate, and correlated double sampling digital error correction. It is available in 28-pin dual in line plastic 24-pin SOIC packages. An evaluation unit with a PC interface board and software is available and is strongly recommended for testing and evaluation.

For further information circle 274 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 2700.

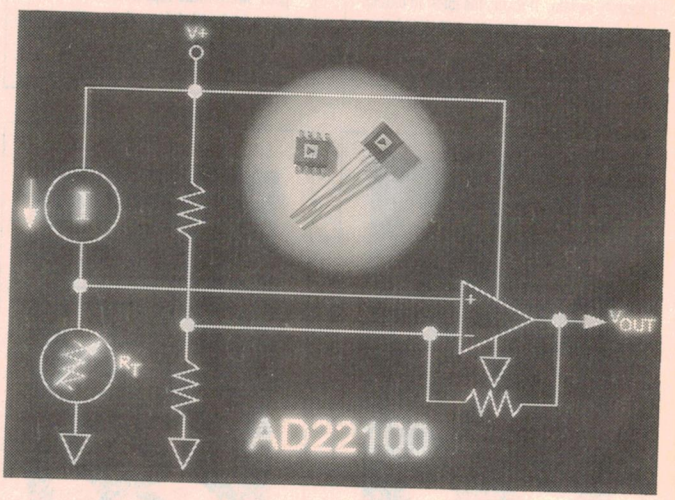
IC temperature sensor

Unlike many equivalent devices which require a negative supply to measure below 0°, Analog Devices' AD22100 can measure from -50° to 150°C, while operating from a single four to 6V supply.

The device is a ratiometric temperature sensor IC whose output voltage is proportional to both the temperature and the supply voltage. In systems which use the positive power supply rail as the system reference, the AD22100 eliminates the need for a separate, precision reference.

Applications include industrial systems, battery powered instrumentation, and automotive systems. The sensor IC is suited to temperature measurement with microprocessor/microcontroller based systems. Many portable, battery powered systems use the positive supply rail as the system reference to maintain maximum system headroom. Because the AD22100's output is ratiometric to the reference input, circuits using the positive supply as the system reference are unaffected by the gradual loss of supply voltage as the batteries are drained.

The heart of the sensor is a temperature dependent resistor built into the IC. Functionally, the device is equivalent to a temperature sensing resistor combined with scaling resistors and signal conditioning, providing an easy to use voltage output indicating temperature.



The AD22100 is available packaged in either a three pin plastic TO-92 or an 8-pin SOIC.

For further information circle 271 on the reader service coupon or contact NSD Australia, 205 Middleborough Road, Box Hill 3128; phone (03) 890 0970.

'16 megabit' DRAM is 18-bits wide

Toshiba has introduced a new '16 megabit' DRAM with 1M words, with an 18-bit structure. The new device is particularly suited for workstations and high end personal computers requiring highly reliable high speed data processing, and also makes possible a reduced chip count.

The TC5118180AJ has a standard capacity of 1M words of 16-bits, with the additional 1M word x 2-bit capacity providing the parity bits. This structure meets the requirement of the parity check system built into computers, and gives highly reliable data processing by checking data to ensure signals are free of errors. Parity checking is increasingly used in workstations and high end personal computers.

The DRAM operates at 5V and is available in a 400-mil wide, 42-pin SOJ package. Toshiba will also introduce 3.3V operating versions and 400-mil wide 50-pin TSOP package types.

For further information circle 277 on the reader service coupon or contact Toshiba Australia, PO Box 350, North Ryde 2113; phone (02) 887 3322.

20-bit delta-sigma audio D/A converter

A low cost, dual voltage output, 20-bit delta sigma D/A IC designed for digital audio applications has been released by Burr Brown. A digital filter and low noise output amplifier is included on-chip. This D/A converter is ideal for general purpose, high volume audio applications such as portable automotive CDs, laser disc players, and musical instruments. It also suits the newly emerging digital set-top box tuners for cable and satellite TV, CD-ROM, photo-CDs, HDTV, and digital audio broadcasting.

The IC's multi-level fourth order delta sigma architecture is claimed to be better than one bit delta sigma D/A converters as it improves noise performance and eliminates sensitivity to input clock jitter and RFI (radio frequency interference). Its high performance on-chip low noise amplifier and 8X over-sampling digital filter reduce the need for external components. Multiple built-in functions such as the digital attenuator, digital de-emphasis, and soft mute increase design flexibility and reduce costs.

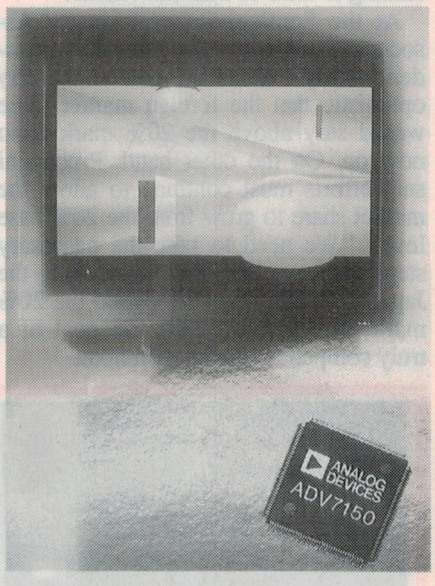
The device operates from a single +5V supply and is available in a compact 28-pin surface mount package. A demonstration board is available for testing and evaluation.

For further information circle 280 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 2700.

Triple 10-bit video RAM-DACs

Each IC in Analog Devices' ADV715x series of RAM-DACs combines three 10-bit video digital-to-analog converters (DACs) and associated colour palette RAM in a single package. Claimed as the industry's first monolithic RAM-DACs, the new devices can deliver 24-bit true colour performance at rates up to 220MHz. Four other family members operate at 170MHz, 135MHz, 110MHz and 85MHz for use in a range of video display units.

The ADV7150 and ADV7152 feature three 8-bit control inputs (one for each of the red, green and blue channels) which provide 2563 (nearly 17 million) addressable colours. Their companion, the pseudo-colour ADV7151 can display images of equal resolution, but with a choice of only 256 colours per frame. In addition to its three 10-bit DACs, the ADV7151 integrates three 256 x 10 (one



256 x 30) colour look-up tables, palette priority selects, clock generator/divider, and a pixel input data multiplexer capable of 1:1, 2:1 and 4:1 operation (see block diagram). Its look-up table enables on-chip linearisation, including gamma correction and monitor calibration. The ADV7151 also contains a number of on-chip test registers for self diagnostics. All three devices operate from a single +5V supply and consume less than 350mA.

For all three RAM-DACs, analog video outputs are RS-343A and RS170 compatible. The ADV7150 is packaged in a 160-lead plastic quad flatpack (PQFP); the ADV7151 and ADV7152 are in 100-lead PQFPs.

For further information circle 278 on the reader service coupon or contact NSD Australia, 206 Middleborough Road, Box Hill 3128; phone (03) 890 0970.

800MHz op-amp

Analog Devices has released the AD8001, an op-amp with a unity gain bandwidth of 800MHz (-3dB). It uses 5mA of supply current (on +/-5V supplies) and consumes only 50mW of power.

For processing high speed video signals in HDTV equipment, professional cameras, and graphics workstations, the AD8001's video specific parameters include 0.1dB gain flatness to 100MHz and 0.01% differential gain error. Other specifications include 1200V/us slew rate and 10ns settling of 2V steps to within 0.1%. A single AD8001 can provide 70mA of output current and drive up to six back-terminated (75 ohm load) cable lines.

Full power bandwidth, a critical specification in communications equipment and medical instrumentation, is 125MHz with 5Vp-p signal swings. The AD8001's worst harmonic component at 20MHz is -60dB; voltage noise at 10kHz is 1.8nV/√Hz. Other applications include RF and fibre-optic receivers, CCD cameras, microwave intrusion detectors and other surveillance equipment, spectrum analysers, and laser diode drivers. The AD8001 is packaged in 8-pin plastic DIP and SO-8 and operates over the extended industrial temperature range of -40° to +85°C.

For further information circle 281 on the reader service coupon or contact NSD Australia, 205Middleborough Road, Box Hill 3128; phone (03) 890 0970.

Silicon Valley NEWSLETTER

Memory shortage feared for 1995

A DRAM memory chip shortage is expected to hit the computer industry late this year or early in 1995, as Japanese DRAM suppliers have been slow to put their 16Mb chips into high volume production. Dataquest analysts have predicted that demand for 16Mb DRAM chips will likely exceed supply later this year and by as much as 20% in the first quarter of 1995. The 16Mb DRAM supply will be crucial for buyers, as 16Mb DRAM became more cost effective than 4Mb DRAM in the second half of 1994.

"As suppliers devote more manufacturing resources to 16Mb DRAM in anticipation of a price crossover from 4Mb DRAM, increased demand from the PC industry could create a shortage of DRAMs," said Mark Giudici, director and principal analyst of Dataquest's Semiconductor Procurement service. "Year end pricing for 16Mb DRAM will be higher than originally expected."

The Dataquest forecast is based in large part on the assumption that worldwide PC unit shipments will grow at a 15% rate for 1994, while the US PC market growth rate should approach 16%. The average memory per desktop/deskside PC will increase from 5.5MB in 1993 to nearly 8MB for 1995. Dataquest does not believe the Japanese are equipped to handle the demand to meet that trend.

"On the supply side, variables such as DRAM yield improvements and wafer fab spending will determine whether the potential 16Mb shortfall lasts several months or for all of next year," said Ronald Bohn, senior industry analyst, Dataquest's Memories Worldwide service.

Foreign chip market stabilises above 20%

The foreign share of Japan's $24 billion semiconductor market has topped the 20% level for two straight quarters, for the first time in history. But after rising sharply in the fourth quarter of 1993, the first quarter market share stayed flat at 20.7%.

US Trade Representative Mickey Kantor said that while foreign manufacturers' share of the Japanese computer chip market was flat in the first quarter, he was 'pleased' by the latest data.

But, Kantor added, "We believe there is still great potential for further progress. We will continue to work closely with the Japanese to ensure that the gradual and steady improvement in market access called for under the arrangement is achieved. Given the renewed commitment of both our governments to work toward successful agreements under the framework talks, such progress is vital."

A year ago, the foreign market share in the first quarter declined sharply from the previous fourth quarter and continued to decline in the second and third periods, leading to talks of trade sanctions.

At the Semiconductor Industry Association office in San Jose, SIA president Andy Procassini was cautiously optimistic that the foreign market share would stay above the 20% mark from now on. On the other hand, Procassini said efforts must continue to allow the market share to grow from the 20% base level. "We need to take the necessary steps to ensure that foreign access to the Japanese market moves beyond the 20% mark, in order to realise the goal of a truly competitive Japanese market."

Procassini added that under the terms of the 1991 US-Japanese Semiconductor Trade Agreement, the foreign market share must show 'steady and gradual progress' through the end of 1996. The apparent failure to live up to that part of the agreement in 1993 when the market share showed a steady quarter-to-quarter declining trend, caused trade friction that would have brought sanctions against Japan had it not been for the fourth quarter surge.

Hughes to get only $114M in satellite case

A federal judge has ordered the US government to pay Hughes Aircraft US$114 million for repeatedly infringing over a span of two decades on a pioneering communications satellite patent. Hughes is a subsidiary of GM Hughes Electronics. However, the award was much less than the US$8 billion Hughes had been seeking.

Judge James Turner of the US Court of Federal Claims in Washington DC ruled on a two part formula to determine the compensation to Hughes, which was awarded a US patent in 1966 for a satellite attitude control system invented by scientist Donald Williams in 1959.

Pity the poor magazine editor or writer who visits one of the larger US trade shows! This shot, taken at the last Consumer Electronics Show, reveals the interior of the press tent — with rows and rows of tables bulging with press kits and background information.

Turner in August 1993 ruled that 81 spacecraft, manufactured by contractors other than Hughes for or on behalf of the US government, violated the Hughes patent and had a value of nearly US$3.6 billion. At the latest hearing, Turner said he had set a royalty rate of 1%, which accounts for nearly $36 million of the award. An additional $78 million was awarded for back interest.

Hughes filed its lawsuit in 1973. The lawsuit was one of the longest running patent infringement cases against the government. The dispute involves the invention of a satellite attitude control system that proved to be the solution to a problem which had stymied government and private industry scientists. The inventor which was characterised by NASA at the time, as a 'unique' and 'important patent,' made the geosynchronous satellite practical and ushered in the age of global satellite communications.

In July 1963, the Hughes-built Syncom using the Williams invention became the first satellite to operate successfully in geosynchronous orbit, about 22,200 miles above the equator. In this orbit a satellite's velocity matches the rotation of the earth and appears to hover over the same spot, allowing 24-hour use of the satellite through fixed ground antennas.

The American public was first introduced to the advantages of Syncom with the live broadcasts of the 1964 Tokyo Olympics.

Sony picks US chip for new video game

Sony has chosen a MIPS based microprocessor from LSI Logic to power its forthcoming 'PlayStation' video game, which is expected out early next year. This marks the first time that an American company has supplied so key a component to a Japanese game maker.

The LSI chip has a MIPS microprocessor at its core, augmented by two additional processors to handle video compression and graphics control. The advanced CD-based video game by Sony Computer Entertainment, expected to debut at US$400 to $500, will have 3-D graphics and the ability to move characters with the smoothness of television.

The selection of Milpitas based LSI Logic is further evidence that US companies will be able to compete in Japan's consumer electronics market. Earlier, Nintendo teamed up with Silicon Graphics to develop its 'Project Reality', a 64-bit video game system. But Nintendo is expected to continue to rely on NEC or Toshiba to manufacture its chips. And Hitachi will keep making chips for Sega, now developing its 32-bit Saturn game.

"I don't think American competitiveness is the issue anymore," said LSI chief Wilf Corrigan. "The real story, now, concerns Japanese competitiveness." As video games become less toylike and more computerlike, US chip companies are finding the transition plays to their strengths. "Now what was once regarded as a trivial consumer item — the video game — is using the same technology we've developed for workstations," Corrigan said.

HP acquires CaLan

Hewlett-Packard has signed an agreement to acquire CaLan, a supplier of test equipment for the cable TV industry. Terms of the agreement were not disclosed. The acquisition makes sense both in terms of HP's leadership in the test equipment industry, as well as its recent aggressive move to become a leading supplier of television products, including set top boxes, media servers, and other products for the new age of interactive television.

"Our technology strengths and market position, with the addition of CaLan's capabilities, will create world leading solutions for the cable-TV industry," said Duane Hartley, general manager of HP's Microwave Instruments division. "Our combined resources will help facilitate the industry's transition from current analog technology to tomorrow's information highway."

This relationship will accelerate our development in support of the broadband industry," said Syd Fluck, CaLan founder and chief executive offer. "Combining our strengths is the right thing to do."

Cable-TV operators will now have a single, full service supplier with a comprehensive offering of test and measurement products, and network monitoring systems. CaLan has been a leading supplier of cable-TV test, measurement and monitoring systems. CaLan was the first to develop non-interfering cable-TV test equipment (1986). This feature allows cable-TV technicians to perform tests and measurements without interrupting TV reception — a breakthrough for subscriber satisfaction and system management efficiency.

Packard Bell surprises with all-in-one PC

It's a Phone. It's a fax. It's a TV. It's a radio. It's an answering machine... It's the new all-in-one Packard Bell PS.

Packard Bell, the PC vendor least noted for product innovation, has set a possible new industry standard with a PC that incorporates a host of consumer and business products, including telephone, fax, answering machine, radio, and television, into a single PC. The machines will sell for between US$1000 and US$3000 depending on the microprocessor and amount of memory and data storage.

To date, Packard Bell has competed almost exclusively in the basis of price, allowing the company to become the second largest PC vendor in the United States — trailing Compaq, but moving ahead of Apple and IBM. The new systems, however, represent the first time a PC vendor has integrated sc many features into an all-round home and business appliance.

"This is the emergence of an industry trend in which numerous appliances in the home are merging together into a single centrepiece," said Beny Alagem, chief executive of Packard Bell in Chattsworth in Southern California.

With the new 486 and Pentium based Packard Bell computers, a user can turn on the computer's radio or TV with a double click of a mouse button. Control panels come up on the monitor for channel selection, volume, tone, brightness and other functions. The TV picture can be adjusted from the size of an icon to full screen. The computer also records incoming telephone messages and send and receives faxes.

The new systems come with stereo speakers, and nearly every model has a CD-ROM drive as a standard feature. They also come with 27 software titles, including 11 CD-ROMs. Finally, the company is also bringing a little fashion to the eggshell-dull computer world with removable plastic panels that can dress a machine in exotic colours such as teal, azure and Sahara.

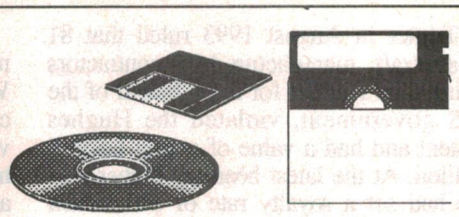
IBM to make Nexgen's Pentium clone

Nexgen has moved a giant step closer to getting a piece of the multi-billion dollar Intel processor pie, as the developer of the industry's first Pentium clone processor has signed up IBM to manufacture its chips. Under the agreement, IBM will make so-called Nx586 chips at its Burlington, Vermont plant, which has excess capacity.

Nexgen announced its clone of Intel's chip in March, after earlier plans for 386 and 486 clones were scrapped. The success of the Nx586 hinges on Nexgen's ability to find a good manufacturing partner because it does not own a factory. IBM, which is one of the few companies that has the state of the art chip facilities to produce the complex processor, certainly adds a lot of credibility to Nexgen. In addition to IBM, Nexgen is also supported by Compaq and Olivetti, each of which owns a sizable interest (13% and 5% respectively) in Nexgen.

Atiq Raza, Nexgen's president and chief executive, said his company intends to undercut Intel prices by between 20 and 30%. ❖

SPOTLIGHT ON SOFTWARE



Spectra Plus: audio analyser

Need to do frequency analysis of audio signals? If you have a '386 or better PC with *Windows 3.1* and a standard sound card, you already have the hardware you need. Couple it with a new low cost software package called *Spectra Plus*, and you'll have a PC-based audio frequency analyser of very impressive performance...

by JIM ROWE

Nowadays, a lot of audio signal analysis tends to be based on digital signal processing techniques — with the incoming analog signal(s) first turned into a set of digital samples, and then techniques like FFT (fast Fourier transformation) used to analyse the sampled information and perhaps convert it from the time domain into the frequency domain. That's the kind of technique used in loudspeaker testing systems like MLSSA, for example, or the Liberty Instruments/EA 'IMP' system that Rob Evans has been describing.

Until now, most of these systems have required their own custom hardware, to perform the initial A-D conversion, etc. But now that many PCs are being fitted with sound cards, which virtually all provide the hardware for digitising audio signals, the logical question arises: couldn't one of these PCs be used for audio signal analysis, by adding the right software? And the answer, of course, is yes. In fact one such software package has just become available.

Spectra Plus has been developed by Pioneer Hill Software, a US firm based in Poulsbo, Washington. It's quite a low cost package, which runs under *Windows 3.1* on IBM compatibles with '386 or better processors and 4MB or more of RAM, and a VGA or better monitor. It also needs a sound card, of course, and one that is *Windows*-compatible. Ideally it should be one that is capable of 16-bit sampling, and at up to 44.1kHz if you want to analyse signals over the full audio spectrum.

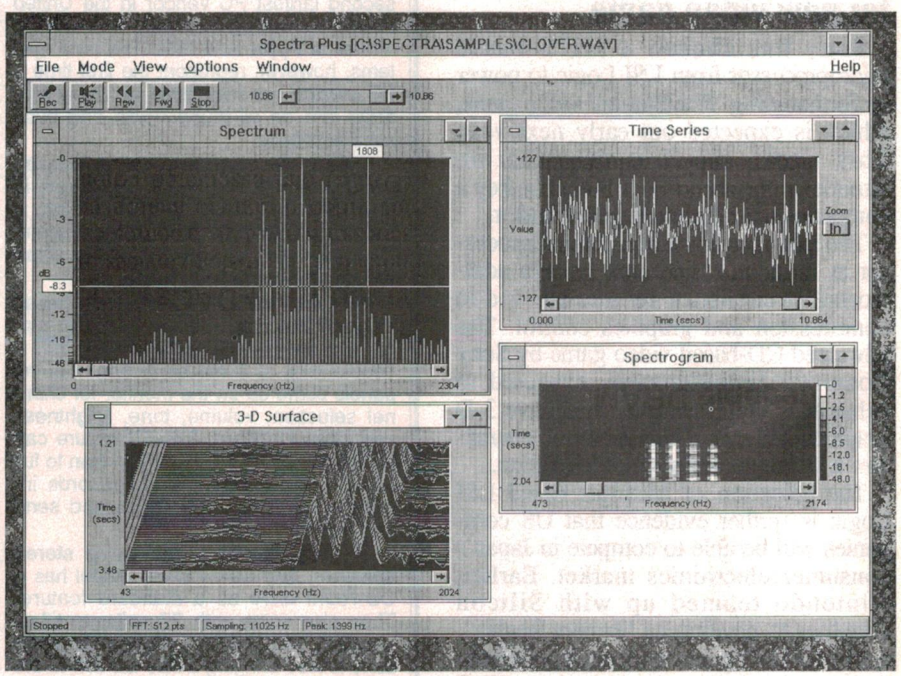
What *Spectra Plus* provides, basically, is a choice of four ways of looking at a signal: a 'time series' view (i.e., amplitude vs time, as seen on an oscilloscope), a spectrum analysis view (the signal's components in the frequency domain, as shown by a spectrum analyser), a 'spectrogram' view showing how the frequency components vary with time, and a '3D surface' view which gives essentially the same information as the spectrogram, but presented more along the lines of a 'waterfall' diagram.

Any or all of these four views can be displayed on the screen in colour, and updated in virtually real time — while listening to the signal as well, in the case of signals which have been saved in .WAV file form.

You have a choice of either performing this analysis in real time, with the signal fed into the sound card's microphone or line level inputs, or alternatively recording the signals on disk as a .WAV file and then using *Spectra Plus* to perform 'post processing'. The latter mode allows additional processing features, such as overlap processing for improved resolution, and triggering the start of processing at a particular point in the signal waveform.

By the way, there's a lower-cost version of the program called *Spectra Vision*, which offers only the real-time analysis mode.

Spectra Plus offers an impressive degree of flexibility when it comes to processing options and analysis parameters. For a start, it will cope with



A screen dump showing the four different 'views' available with Spectra Plus. At upper right is the Time Series view, as displayed on a scope, while the basic time domain or Spectrum view is at upper left — complete with measurement cursors.

signals sampled at virtually any rate from 4kS/s to 44.1kS/s, as supported by your sound card, and with either 8-bit or 16-bit sampling (although only in mono). Needless to say, the frequency measurement range is from 0Hz to half the sampling rate (i.e., the Nyquist limit). The rated dynamic range is greater than 70dB with 16-bit sampling.

There's a choice of five FFT sizes, namely 128, 256, 512, 1024 and 2048 points. The rated update speed with a 1024 point FFT is better than 15 per second, running on a '486/50MHz machine.

Exponential moving block averaging can be used to clean up the spectrum views, with user-selectable block size. With overlap processing (in post processing mode), the overlap can also be set for up to 99% of FFT size. A choice of Uniform, Hanning, Hamming or Blackman smoothing windows is also available, to control 'leakage' due to sampling end effects.

In the spectrum views, the amplitude scaling can be selected as either linear or logarithmic, with either manual or automatic positioning of the 0dB reference. The program always tracks the peak amplitude component, and indicates its frequency on the status line at the bottom of the screen display. Also displayed on the status line are the sampling rate, current FFT size and the program's operating status.

Spectra Plus allows you to set up to three 'frequency markers', which appear as lines on the various spectrum views. In addition, you can determine the exact vertical and horizontal co-ordinates at any point on each of the four 'views', simply by positioning the mouse cursor at the point of interest and pressing the left mouse button. Two cursor lines immediately appear, with legends at their axis ends showing the corresponding values. This is excellent for checking the frequency and amplitude of individual components in one of the spectrum views, for example.

Needless to say, *Spectra Plus* will let you print out any of the views (via any *Windows* supported printer), to get them in hard copy form. As with other *Windows* applications you can also use the clipboard to capture complete screens, if you wish, and print these out via a graphics program such as *Corel Draw*. That's how the screen grab shown was produced, in fact.

Trying it out

We installed the review copy of *Spectra Plus* on a 486/33MHz machine, fitted with a Sound Blaster 16 card (kindly provided by Dick Smith Electronics for review — so we were able to use it for this review as well). It installed very easily using the usual *Windows 3.1* Program Manager 'Run' facility to call a SETUP program on the distribution floppy.

Since the sound card had previously been installed, running it was then simply a matter of clicking on the 'Spectra' icon which appears in the Program Manager window after installation.

The package needs only about 1MB of hard disk space, for the *Spectra Plus* program itself, a help file and a set of nine sample .WAV files to get you going.

We tried out the program first with these sample files, which include recordings of noises such as a jet passing overhead, a brake drum being ground and a four-cylinder engine operating.

There are also recordings of a variety of digital data communication signals, such as 200Hz and 800Hz shift FSK teletype signals, a four-tone CLOVER signal and a satellite telemetry signal. These are all quite interesting to examine, and are certainly good to use while you're getting familiar with the many features of *Spectra Plus*.

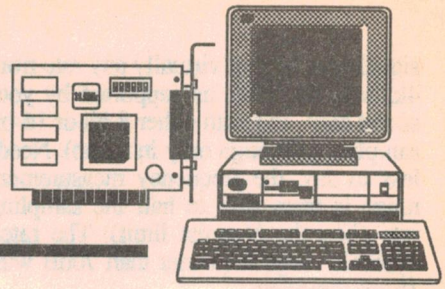
Following this we tried feeding in other signals of our own, such as the sounds from a few different voices on a synthesiser keyboard, a few spoken phrases via a microphone, and a few different waveforms from a function generator. These were also very interesting to analyse, and again demonstrated how many potential uses there are for this kind of audio analyser.

About the only gripe we have about the package is that the user manual is pretty sketchy, and has fairly obvious errors in a few places. For example in the discussion of FFT size and its effect on frequency resolution, it gives an example suggesting that with a sampling rate of 8192S/s, an FFT size of 1024 points gives a resolution of 4Hz, because '8192/1024 = 4Hz'...

Overall, though, the *Spectra Plus* package has a lot of very impressive features. It's also very friendly and easy to drive, and for the quoted Australian price of $269 plus courier delivery for $6.50 within Australia, it seems to us very good value for money. (The simpler *Spectra Vision* package is only $139 plus the courier fee.)

The Australian distributor for Pioneer Hill Software is ME Technologies, of PO Box 50, Dyers Crossing 2429; phone (065) 50 2200 or fax (065) 50 2341. Our thanks to ME for the opportunity to try out *Spectra Plus*, and to DSE for the loan of a Sound Blaster card for the review. ❖

Computer News and New Products



International PCMCIA faxmodem

Intel Australia has announced its PCMCIA faxmodem certified for international use with mobile computers.

Intel claims its new International Faxmodem is the only PCMCIA faxmodem to be certified for use in multiple countries, allowing international travellers to use a single faxmodem when travelling in the approved countries.

With accompanying Switch-It software, users choose from a list of certified countries and the faxmodem automatically configures to work with the selected country's local telephone system.

The faxmodem is certified for use in Australia, the United States, Canada, the United Kingdom, Germany, France, Norway, Denmark, Sweden, Finland, the Netherlands, Singapore, Iceland and Poland. Other countries which will be on the list include Hong Kong, Italy and New Zealand. The faxmodem operates at 14,400bps fax and data modem speeds. Other features include: hot swap capability which allows users to insert or remove the card without having to exit a Windows (or DOS) application or restart the system, and a power save feature for drawing near zero power when the card is not in use.

The Intel International Faxmodem for PCMCIA will be distributed by Tech Pacific, NJS Electronics and Merisel Australia. Recommended retail price is $699.

For further information circle 163 on the reader service coupon or contact Intel Australia, PO Box 1486, Dee Why 2099; phone (02) 975 3300.

1GB low profile 3.5" drive

Micropolis Corporation has announced its new IDE drive, the Taurus 4110A. The drive is a low profile, 3.5" IDE disk drive which Micropolis claim is 20% faster and 30% cheaper than previous models. According to Micropolis the model 4110A is a 'plug and play' storage solution that is easily installed by the user into the majority of computers used on the desktop today.

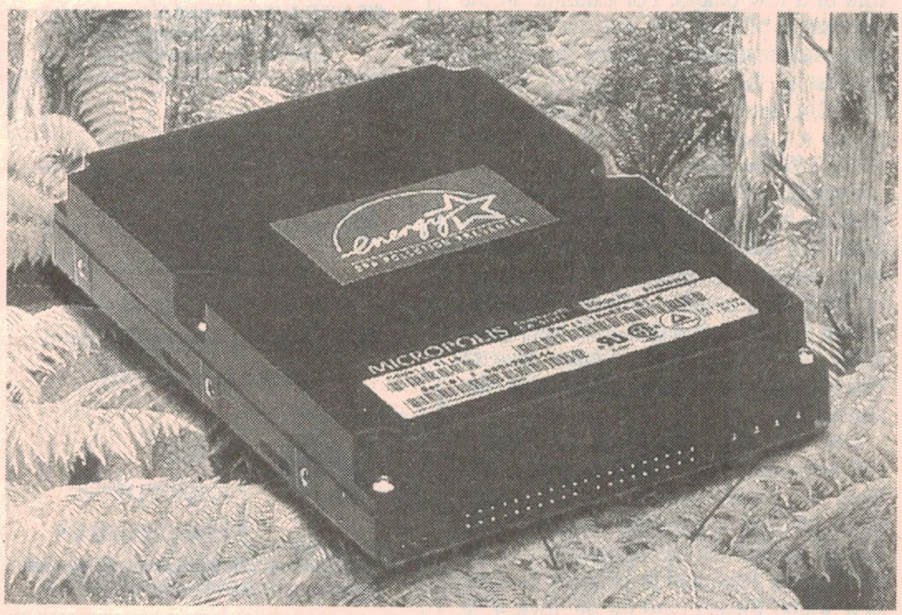
Combining 1.057 gigabyte (GB) of storage with a space saving, one inch high profile and new energy saving features, the drive suits the new generation of powerful PCs, workstations and super servers that demand high capacity, high performance, and low power consumption.

The power consumption of the unit is 8.25 watts and its built-in automatic power down feature further reduces power consumption during extended periods of inactivity.

The drive spins at 4300rpm, reducing the average rotational latency to 5.56ms. The on-board IDE controller provides a high speed data transfer rate of up to 10MB per second. The 4110A incorporates new electronics that provide an average seek time of 8.5ms. The drive has a mean time between failure (MTBF) of 500,000 hours and is backed by a five year warranty.

The Taurus 4110A has an estimated street price of $1500 (inc.tax).

For further information circle 161 on the reader service coupon or contact Micropolis, 201 Miller Street, North Sydney 2060; phone (02) 959 2326.



Updated SPICE library disk

Analog Devices' new free ADSpice library diskette, contains a total of 392 advanced SPICE models. Revision 1 adds 40 new macromodels including the AD810, AD812, AD813 video amplifiers, AD581, AD584, AD587 references, and the BUF04 high speed buffer.

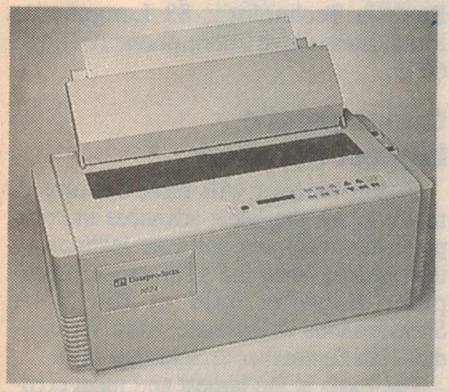
All models use state of the art simulation techniques, providing designers with the ability to emulate AC and DC performance, as well as thermal, noise and other behavioural characteristics.

In addition to these new models, ADSpice features many of the company's operational amplifiers, instrumentation amplifiers, analog multipliers, voltage references and matched transistor pairs. Critical performance parameters such as noise, bandwidth and phase response are available.

780cps matrix printer

Dataproducts has introduced an enhanced version of its 8524 high performance matrix printer. Nicknamed 'ToughWriter', the printer is for high volume printing applications of up to 15,000 pages per month.

Letter quality printing is produced by a 24-wire print head. Other features include graphics resolution up to 360dpi,



10 resident fonts, 13 resident barcode symbologies, compressed print up to 24cpi, programmable vertical spacing in 1/360 inch steps and six print speed/quality combinations up to 780cps. A dual parallel/serial interface provides interconnect flexibility.

Paper handling includes the ability to print on up to 100gsm stock and up to nine part forms.

Continuous forms up to 16 inches wide are supported as are cut sheets in A4, A3, B4, B5, letter and legal sizes. Paper handling features also include zero tear-off, paper park, autoload, autoscroll and label print mode.

Options include pull tractors, a single-bin cut sheet feeder, RS-422A interface and a paper stacking shelf. The 8524 has a list price of around $3200 including tax.

For further information circle 164 on the reader service coupon or contact Dataproducts, 10 Rodborough Road, Frenchs Forest 2086; phone (02) 451 3533.

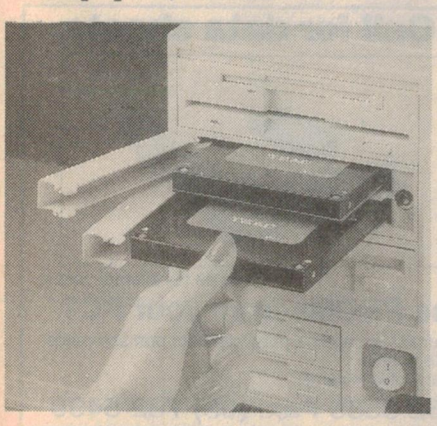
The free Spice library is available on a 3.5" IBM PC compatible diskette from NSD Australia, 205 Middleborough Road, Box Hill 3128; phone (03) 890 0970.

Dual removable hard drive

TEAC Corporation in Japan has released a range of dual bay removable hard disk drives to complement their current single bay unit.

The kit comprises a dual docking bay that fits into a standard 42.8mm high, 5.25" floppy disk drive slot, a hard carry case, a configuration disk, installation guide and a removable hard disk drive. A second drive is available as an option. Capacities are 250MB, 360MB and 540MB, giving a maximum capacity of 1.08GB, with an IDE interface.

The dual docking bay can be locked, giving security while in use. A back-up using the second drive takes around 2.5 minutes for 250MB. TEAC also offer a hot swap option, which allows the user to change drives on the fly. This means a drive can be changed without changing CMOS settings. This option is aimed at those who need an almost unlimited hard disk drive capacity.



For further information, circle 165 on the reader service coupon or contact Southend Data Storage, PO Box 25, Menai 2234; phone (02) 541 1006.

Database disks for radio amateurs

RCS Radio has available two new database disks for radio amateurs using MS-DOS computers, providing callsign-linked cross reference information on VK amateurs.

MINICALL is a VK surname to callsign cross reference, with an additional field available for each record in which can be stored comments, telephone number, sched data etc. The database on this disk is compressed and requires approximately 5MB of hard disk space when installed. It comes on a 1.4MB floppy and is available for $15.00 including P&P within Australia.

CALLDISC is a more powerful VK database than MINICALL, offering searching by operator surname, street, postcode or callsign. It also has WIA Councillor listings together with Federal Coordinator, Federal Councillor, etc. A printout feature also allows printing out say a selected postcode grouping — for seeing who is in your area, the nearest examiners etc.

It can also print out a full surname-sorted listing (300 pages!). This disk also comes on a 1.4MB floppy,. but requires

8.5MB of hard disk space for installation. It costs $25.00 including P&P.

Further details are available from Bob Barnes, RCS Radio, 651 Forest Road, Bexley 2207; phone (02) 587 3491 or fax (02) 587 5385.

Remove unwanted Windows files

Uninstaller is a program that removes unwanted Windows 3.1 files, such as superseded drivers, font files, and duplicate files. It checks DLL, DAT and DRV files and removes those no longer being used by any Windows applications. After running Uninstaller, most Windows users will gain additional disk space and increased performance speed. There is an Undo option to restore an application that has been accidently uninstalled. The program also removes unwanted entries in WIN, INI, AUTOEXEC.BAT, CONFIG.SYS and SYSTEM.INI files, and deletes orphaned files (files that can no longer be used).

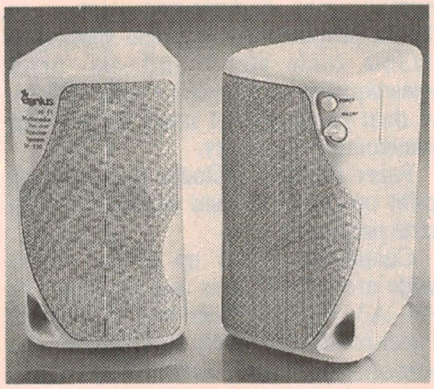
For further information circle 162 on the reader service coupon or contact Software Suppliers, 7 Avon Road, North Ryde 2113; phone (02) 888 1955.

Hifi speakers for multimedia PCs

Genius Australia has released a high quality, hifi stereo speaker system to cater for the growing multimedia PC market.

The system is designed to connect to a wide range of sound cards to create a multimedia sound environment. It can be mounted on to the monitor to save desk space and connects directly to a power point. The volume switch is located on the front panel.

The speaker system features magnetic shielding to minimise the risk of disk



drive data loss and visual distortion of the monitor. It consists of two eight watt, 7.5cm cone type speakers with built-in amplifier, which is suitable for use in an office or an average sized room. The stereo sound package, which retails for $99, is available from computer outlets around Australia. It contains two speakers, a stereo jack as well as speaker braces and a monitor strap, base stands and a screwdriver for easy installation.

For further information circle 169 on the reader service coupon or contact Genius Australia, 4 Briar Street, Fulham Gardens 5024, phone (08) 235 2388.

14.4K pocket fax/modem

Banksia Technology has launched MyPocketModem, a 14,400bps pocket fax/modem targeted at the small office/home office (SoHo) market. The new device has an effective data throughput of up to 57,600bps achieved by combining the tiny modem's high speed with V.42 and MNP 24 error correction and V.42bis and MNP 5 data compression. The unit is a mini version of the Banksia MyModem.

The full duplex, asynchronous MyPocketModem is battery or mains powered. It allows fax transmission to operate in background mode and has a broadcast fax capability. An auto detection feature distinguishes between incoming faxes and data calls online.

It is designed and manufactured in Australia and approved for use here and in New Zealand. It is backed by Banksia's two year warranty and full technical support from a nationwide network of resellers, and has an RRP of $599.

For further information circle 170 on the reader service coupon or contact Banksia Technology, 83 Longueville Road, Lane Cove 2066; phone (02) 418 6033.

Queensland's biggest PC show

Queenslanders will have an opportunity to see the latest advances in computer hardware and software technology this month, when the 12th annual Computer Expo is held at the RNA Showgrounds in Brisbane, from Wednesday 12th September to Saturday 15th.

The Expo is the largest and most comprehensive of its kind held in Queensland, and over 150 exhibitors are expected to be displaying their products and services, over two levels of the exhibition building.

Companies exhibiting include IBM, Apple, NEC, Hewlett-Packard, Optima, Byte Power, 3M, Sony, Panasonic, Fujitsu, Epson, Canon, Toshiba, Sharp, Star, Olivetti, Citizen, Western Digital, Microsoft, Sybiz, Wordperfect and many more.

A feature of the '94 Expo is the 'business only' day on Wednesday 28th, designed to increase contact with the business community by allowing business people to see products, take part in meaningful discussions and speak with key personnel. The other three days are open to both business and the public. The Expo opens at 10am each day; admission is $7.

For more information contact Queensland Exhibition Services, (07) 846 4777 or fax (07) 846 2811. ❖

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All **TECS** computer systems are assembled in-house by our own technicians using high quality, brand new parts. This enables us to maintain the top level of standard that our customers demand.

Our systems are proving their reliability and ruggedness in some of the finest institutions such as the Physics department at Victoria University, Dept. of Biochemistry at the University of Tasmania, Dept. of Elect. & Comp. Syst. Eng. at Monash University, and many others.

486SX-33 @$1535	486DX-40 @$1740
486DX2-50 @$1800	486DX2-66 @$1875

Configuration: 4M RAM, 210M HDD, 1.44M FDD, 1M SVGA card, 2S/1P/1G ports, 101 keyboard, 14" SVGA monitor, in your choice of desk-top or mini-tower case. (add $75 for MS-DOS 6.2)

This month only! VL-bus IDE I/O, VL-bus SVGA card, 14" non-int. monitor at NO EXTRA COST!

2 Year parts and 5 Year labour warranty

486DX2-66 MULTIMEDIA SYSTEM

If you're looking for a multimedia system, then look no further. Don't be fooled by others which offer you less. This machine is ***40~50% faster*** than a comparable system using 486DX-33 CPU. Graphics based software requires a fast processor to cope with the vast amount of information that each picture holds.

The double speed CD-ROM drive and the **Sound Blaster 16 TRUE STEREO** sound card assures you that you will be able to run the latest software with total compatibility & reliability.

Configuration: 4M RAM, 340M HDD, 1.44M FDD, P24T upgradeable motherboard, 256K cache RAM, VL-bus I/O, VL-bus 1M VGA card, 14" N.I. SVGA monitor (.28mm DP), Panasonic double speed CD-ROM drive, Sound Blaster 16 sound card, pair of amplified speakers, joystick, genuine Microsoft Ergonomic mouse, Honeywell 101 keyboard, MS-DOS 6.2, Windows 3.11, Works for Windows 3.0 **& Comptons Multimedia Encyclopaedia CD.**

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Please specify:
3.5" 1.44M or 5.25" 1.2M
Available in MS-DOS format only.

SEMICONDUCTORS

DUE TO WORLDWIDE SHORTAGE ON INTEGRATED CIRCUITS, THERE HAS BEEN A SIGNIFICANT INCREASE IN PRICES, SOME AS MUCH AS 100%!!

WE HAD TO INCREASE OUR PRICES, BUT WE BELIEVE WE STILL HAVE ONE OF THE CHEAPEST PRICES AROUND.

DIODES			
1N4148 (PK.100)	$3.50	1N914 (PK.100)	$4.00
1N4004 (PK.100)	$6.00	1N4007 (PK.100)	$7.00
1N5404 (PK.100)	$14.00	1N5408 (PK.100)	$16.00
BRIDGES			
W04 (PK.10)	$5.00	BR64 (PK.1)	$2.00
BR104 (PK.1)	$2.50	BR354 (PK.1)	$4.50
LED's			
3mm RED (PK.100)	$12.00	5mm RED (PK.100)	$12.00
3mm GRN (PK.100)	$15.00	5mm GRN (PK.100)	$18.00
3mm YLW (PK.100)	$15.00	5mm YLW (PK.100)	$18.00
TRANSISTORS			
BC547/8/9 (PK.100)	$8.50	BC557/8/9 (PK.100)	$8.50
BD139 (PK.10)	$6.00	BD140 (PK.10)	$6.00
MJ2955 (PK.1)	$2.00	2N3055 (PK.1)	$1.50
IC's			
324 (PK.10)	$9.00	339 (PK.10)	$8.50
555 (PK.10)	$8.00	741 (PK.10)	$7.00

MOTHERBOARDS

Prices of 486 boards are starting to come down to a realistic level. Check out the new ***low prices.***

All boards feature 256K of fast cache RAM fitted, and three VESA local bus slots.

486SX-33	***$310***
486DX-33	***$480***
486DX-40	***$510***
486DX2-50	***$540***
486DX2-66	***$640***

Full 12 month Warranty

NO BRAND DISKETTES

THESE DISKETTES ARE TOP QUALITY, AND JUST AS GOOD AS SOME OF THE "KNOWN" BRANDS.

LOWER PRICES

WHY PAY FOR FANCY PACKAGING? **FULL SATISFACTION GUARANTEED BY REPLACEMENT OF FAULTY DISKETTES.**

*PLEASE NOTE THAT OUR 3.5" DISKETTES ARE ***PRE-FORMATTED*** FOR YOUR CONVENIENCE.

DESCRIPTION	1+	10+
5.25 360K DSDD	$4.50	$4.30
5.25 1.2M DSHD	$7.00	$6.85
3.5 720K DSDD*	$7.00	$6.85
3.5 1.44M DSHD*	$9.95	$9.50

SUPER FAST 16550 SERIAL CARD

Features:
- user selectable IRQ.
- 2 x serial ports.
- 1 x parallel port.

SPECIAL PRICE $69

PERIPHERAL CARDS

-WHETHER YOU'RE REPLACING A FAULTY CARD OR INSTALLING AN ADDITIONAL CARD, WE CAN OFFER YOU THE RIGHT CHOICE.
-COMPARE OUR PRICES WITH OTHER DEALERS'. YOU'LL FIND OUR PRICES TO BE VERY COMPETITIVE.

XT CLOCK	$22.50
XT/AT SERIAL (1 POP.)	$17.50
XT/AT PARALLEL	$17.50
XT/AT GAMES	$17.50
AT MULTI I/O (2S,1P,1G)	$19.00
AT IDE/FDD	$19.00
AT CACHING IDE CONTROLLER PROMISE DC200	$199.00
AT IDE/FDD MULTI I/O	$25.00
MONO/CGA GRAPHICS	$45.00
512K TRIDENT VGA	$75.00
1M CIRRUS VGA	$109.00
VESA LOCAL BUS CARDS	
1M CIRRUS VGA	$169.00
1M TRIDENT VGA	$129.00
IDE I/O CONTROLLER	$39.00
CACHING IDE CONTROLLER PROMISE DC4030	$249.00

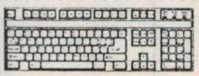
1 YEAR WARRANTY!!

Etch Resistant Ink Dalo Pen

Quickest and the most ideal way to make up a PCB for simple projects. Available in blue, black, red, and white.

Normal street price $5.95 **OUR PRICE $4.95**

SPILL-RESISTANT 101 KEYBOARD



$29

- NO MORE CRYING OVER SPILT COFFEE!!
- ELECTRONICS AND LIQUIDS SUCH AS COFFEE, TEA, AND SOFT DRINKS DON'T MIX.
- IF YOU'VE EVER WORKED LATE INTO THE NIGHT, YOU KNOW THAT COFFEE SPILLS ARE A REGULAR OCCURENCE.
- PROTECT YOUR VALUABLE COMPUTER.
- 1 YEAR WARRANTY.

QUALITY MOUSE AT ECONOMY PRICE!!

THE FAMOUS TRUEMOUSE

- THREE BUTTONS.
- SELECTABLE BETWEEN MOUSE SYSEMS & MICROSOFT MODES.
- UP TO 800 DPI.
- WITH PAD & HOLDER.

NORMALLY $29.50

NOW $25

WE ARE SO CONFIDENT OF THIS PRODUCT THAT WE ARE OFFERING A **7 DAY MONEY BACK GUARANTEE** IF YOU ARE NOT COMPLETELY SATISFIED FOR ANY REASON. THE TRUEMOUSE IS ALSO COVERED BY 12 MONTH WARRANTY.

N.B. ALL RETURNS MUST BE IN ORIGINAL PACKAGE & CONDITION.

IC Socket Sell-out!!

High quality dual wipe IC sockets at low prices.

6 pin (pk.50)	$5.00	20 pin (pk.50)	$10.00
8 pin (pk.50)	$5.00	24 pin (pk.50)	$12.00
14 pin (pk.50)	$7.00	28 pin (pk.50)	$14.00
16 pin (pk.50)	$8.00	40 pin (pk.50)	$20.00

SIM MODULES

1M 70nS	***$69***
4M 70nS	***$279***

HARD DRIVES

210M	$345
270M	$385
340M	$449
420M	$499
540M	$649

EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

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Altronics	WA	•	•	•	•	•	•	•
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TECS	VIC	•	•	•	•	•	•	•
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KEY TO CODING:

A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, $10 for larger boards. Please specify negatives or positives.

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Members of our technical staff are not available to discuss technical problems by telephone.

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ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria, NSW 2015; phone (02) 353 0620.

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HIGH POWER ARGONS

Get real! with a 4–7 WATT! water cooled multi-line argon laser with very low hours of use. Ring for details.

AUDIO POWER ICs & TRANSFORMERS

We have a limited stock of 20 watt TDA1520 Hi-Fi quality monolithic power amplifier ICs: Less than 0.01% THD and TIM distortion, at 10W RMS output! With our transformer we guarantee an output of greater than 20W RMS per channel into an 8 ohm load, with both channels driven. We supply a very overrated 240V:28V 80W transformer, two TDA1520 ICs, and two PCBs which also include an optional preamplifier section (only one additional IC), and a circuit and layout diagram. The combination can be used as a high quality Hi-Fi stereo / guitar / PA, amplifier. Only a few more components are needed to complete this excellent stereo/twin amplifier! Incredible pricing:

$25

For one 240V-28V (80W!) transformer, two TDA1520 monolithic Hi-Fi amplifier ICs, two PCBs to suit, circuit diagram & layout. Some additional components and a heatsink are needed.

INTENSIFIED NIGHT VIEWER KIT

See in the dark! Make your own night scope that will produce good vision in sub-starlight illumination. We supply a three stage fibre optically-coupled image intensifier tube, EHT power supply kit, and sufficient plastics to make a monocular scope.

$290 (25mm version)

$390 (40mm version)

We can also supply the lens (100mm f2: **$75**) and the eyepiece (**$18**) which is everything needed to make an incredible night viewer!

MARINE SEARCHLIGHTS

These BRAND NEW 1/2 metre diameter search lights were made by Lucas in the UK. They are painted grey and are almost totally made of brass, except for a few stainless steel screws and nuts, a mirrored glass parabolic reflector, and a glass cover plate. They have a detachable grey mounting pillar (also made of brass), Total height of the spotlight and the pillar is 2 meters. Fully adjustable positioning and focussing. Supplied with 1000W-240V quartz halogen lamp (T11): 23,000 lumens. Approximate weight of pillar and spotlight is 60kg. CLEARANCE:

$490

LASER POINTER SPECIAL

Not a kit, but a complete commercial 5mW 670nm pen-sized laser pointer at an incredible SPECIAL PRICE:

$99 Item no 0101

12V FANS

High quality, brand new 80mm 12V 1.6W DC fans. These are IC controlled and have four different approval stamps. Big quantity available at very low prices:

$10 ea or 5 for $40

LIGHT MOTION DETECTORS

Small PCB. Assembly based on a ULN2232 IC. This device has a built-in light detector, filters, timer, narrow angle lens, and even a siren driver circuit that can drive an external speaker. Will detect humans crossing a narrow corridor at distances up to 3 metres. Much higher ranges are possible if the detector is illuminated by a remote visible or IR light source. Can be used at very low light levels, and even in total darkness: With IR LED. Full information provided. The IC only is worth $16! OUR SPECIAL PRICE FOR THE ASSEMBLY IS:

$5 ea or 5 for $20 Item no 0163

POLYGON SCANNERS

Precision motor with eight-sided mirror, plus a matching PCB driver assembly. Brand new matching components, from laser printers. Will deflect a laser beam and generate a line. Needs a clock pulse and DC supply to operate: Simple information supplied. Item no 0237.

$25

PCB WITH AD7581LN IC

PCB from used but working late model equipment. Among many other components the PCB contains a Maxim AD7581LN IC, 8-bit, 8-channel memory buffered data acquisition system designed to interface with microprocessors. This high performance CMOS IC contains an 8-bit successive approximation A-D converter, 8-channel multiplexer, 8 X 8 dual port RAM, address latches and microprocessor compatible control logic. The complete PCB assembly is priced at a small fraction of the price of the AD7581LN. Item no 0240.

$29

EHT POWER SUPPLY

These EHT power supplies were designed to deliver –600V, –7.5kV and +7kV for a laser printer, while powered from a 24V-800mA DC supply. They are from brand new equipment, and are contained in a plastic case with overall dimensions of 100 x 85 x 80mm. The electronics inside these supplies contains three separate supplies on two separate PCBs. The output connections are easy to access, and a pre-wired input power connector is also provided: Connecting up information provided. Great for experienced experimenters. BARGAIN PRICED! Item no 0222NS

$16

STEPPER MOTOR DRIVER KIT SPECIAL

This kit will drive two stepper motors: 4, 5, 6 or 8-wire stepper motors from an IBM computer parallel port. A separate power supply is required to run the motors. A detailed manual COMPUTER CONTROL OF MOTORS plus circuit diagrams & descriptions included. Note that no stepper motors are provided with this kit. We also provide the necessary software on a 5.25" disk. Great *low cost* educational kit:

$35

THE SPECIAL?? We will include one of our $14 (5V, 6-wire, 7.5°) stepper motors FREE with this kit!

MORE KITS-ITEMS

SINGLE CHANNEL UHF REMOTE

S.C. Dec. 92 1 x Tx & 1 x Rx **$45** extra Tx **$15**

GARAGE - DOOR - GATE REMOTE CONTROL

Kit: Tx **$18** Rx **$79**

1.5-9V CONVERTER

Kit: (includes PCB) **$6** ea,3 for **$15**

LASER BEAM COMMUNICATOR

Kit: Tx, Rx and IR laser **$50**

PLASMA BALL

PCB and components kit, needs any 240V incandescent light bulb **$25**

MASTHEAD AMPLIFIER

Kit: Two PCBs plus all on board components: Low noise, covers VHF-UHF, excellent price! **$18**

SPECIALS BY FAX

If your fax has a polling function, dial **(02) 579 3955** and press your **POLLING** button to get our latest specials, plus our full item and kit listing. Updated 20th each month

INDUCTIVE PROXIMITY SWITCHES

Detect ferrous and non-ferrous metals at close proximity, some are DC powered (10-30V), some are mains AC powered, and all will switch loads directly. All have three wires for connecting into circuitry: Two for the supply, one for switching the load. These also make excellent sensors for rotating shafts etc. **$22** ea or 6 for **$100** Item no 0192

BRAKE LIGHT INDICATOR KIT

60 LEDs, two PCBs and 10 resistors, makes a very bright, 600mm long, high intensity red display, like those on late model vehicles. On SPECIAL for **$30**.

IR LASER DIODE SURPLUS SPECIAL

BRAND NEW 780nm IR laser diodes (barely visible), mounted in a professional quality adjustable collimator-heatsink assembly. Each assembly comes with a CONSTANT CURRENT DRIVER kit and a PIN DIODE that can be used as a detector, plus some INSTRUCTIONS. Suitable for medical use, perimeter protection, data transmission, IR illumination etc. Experimenters delight SPECIAL PRICE. Item no 0223NS

$28

BIGGER LASER

We have a good, but LIMITED QUANTITY of some brand new red 3mW+ tubes, and some 'as new' red 6mW+ laser heads from new equipment. Tube dimensions (3mW+): 35mm diameter by 190mm long, Head dimensions: 45mm diameter by 380mm long. With each of the lasers we will include our 12V Universal Laser power supply. BARGAIN AT:

$110 3mW+ tube/supply item no 0225A

$170 6mW head/supply item no 0225B

We can also supply a 240V:12V/4A - 5V/4A switch mode power supply to suit for **$28**.

12V 2.5 WATT SOLAR PANEL

SPECIAL These US made amorphous glass solar panels only need terminating and weather proofing. Each panel comes with terminating clips, a slightly larger sheet of glass for backing, an isolating diode and the instructions. The terminated panel is glued to the backing glass, around the edges only. To make the final weatherproof panel look attractive some inexpensive plastic L angle can be glued to the edges with silicone. Very easy to make. Dimensions: 305 x 228mm, $V_{o/c}$ 18-20V, $I_{s/c}$ 250mA. SPECIAL REDUCED PRICE until the end of '94!

$20 ea or 4 for **$60** item no 0226

A very efficient switching regulator kit is available for **$27**: Suits 12-24V batteries, 0.1 - 16A panels, **$27**. A simple and efficient shunt regulator kit is also available, **$8**.

CCD CAMERA

Monochrome CCD camera fully assembled on a small PCB and includes an auto iris lens. It can work with light as low as 0.1 lux or in total darkness with infra-red illumination. Overall dimensions are 24 x 46 x 70mm, weighs less than 40 grams! Can be connected to any standard monitor or the video input of a VCR.

$239 item no 0227

IR 'TANK SET'

ON SPECIAL are the components to make a very responsive infra-red night viewer. The matching lens, tube and eyepiece sets are from working, military quality, IR viewers from tanks. Comes with a very small EHT power supply kit so the tube can be operated from a small 9V battery. The tube is probably the most sensitive IR responsive tube we have ever supplied. Requires low level IR illumination. Basic instructions included. Item no 0228UTS

$120

When ordering, specify wide angle or telescopic objective lens

RUSSIAN NIGHT VIEWER

We have a limited number of passive, monocular, Russian-made night viewers fitted with a 1st generation image intensifier tube. Prefocussed to infinity. CLEARANCE.

$180

OATLEY ELECTRONICS

PO Box 89, Oatley,

NSW 2223

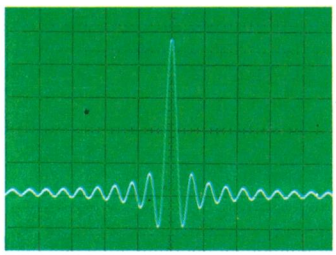
Phone (02) 579 4985 Fax (02) 570 7910 or 579 3955

major cards accepted with phone and fax orders

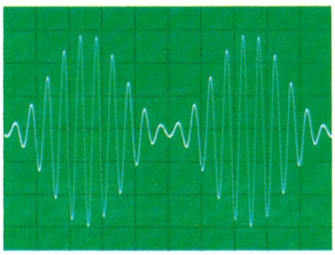
P&P for most mixed orders Aust $6.

READER INFO NO. 2

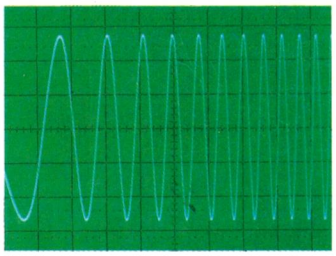
There are many areas where our function generator will surpass your expectations.



A built-in 12-bit, 40 MSample/sec, 16K deep arbitrary waveform generator easily handles your custom waveform needs.

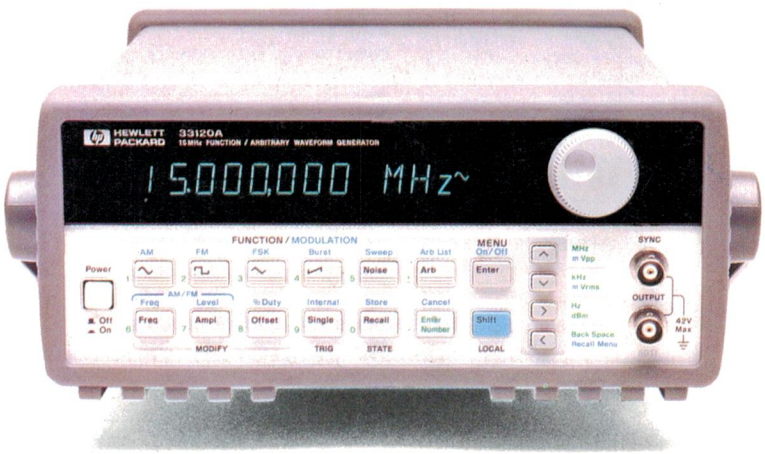


Internal AM, FM, FSK and burst modulation eliminate your need for a second modulation source.



Both linear and log sweeps are built in, making filter and amplifier testing quick and easy.

At a price that falls below them.



The HP 33120A 15 MHz synthesised function/arb generator: Within budget, without compromise.

In the world of function generators, price and performance have always been synonymous. So it's understandable you'd expect to pay more for the measure of confidence you get with a synthesised signal source that delivers stable, accurate signals test after test. Or, for the flexibility to generate complex waveforms with arbitrary waveform capability.

You'd probably also expect to pay a premium for the convenience of built-in sweep and modulation functions. And to have both HP-IB and RS-232 interfaces standard.

Fact is, you can always get high performance with the high price to match. Or, order the HP 33120A fully loaded function/arb generator and get something totally unexpected. A price you can afford.

Call HP to see how much function generator you can get for your money.

Discover just how easy it is to afford a fully loaded 15 MHz function/arb generator with synthesised signal source and arbitrary waveform capability. Once you hear the price, we think you'll agree it's the best deal of any function generator in its class.

In fact, you can learn more about the HP 33120A function/arb generator's custom waveform capability, signal accuracy, easy programmability and any other specifications you may need to make the right decision.

So call our Customer Information Centre on **13 1347** (Australia wide) and ask for extension **2902.**

A better way.

HEWLETT® PACKARD